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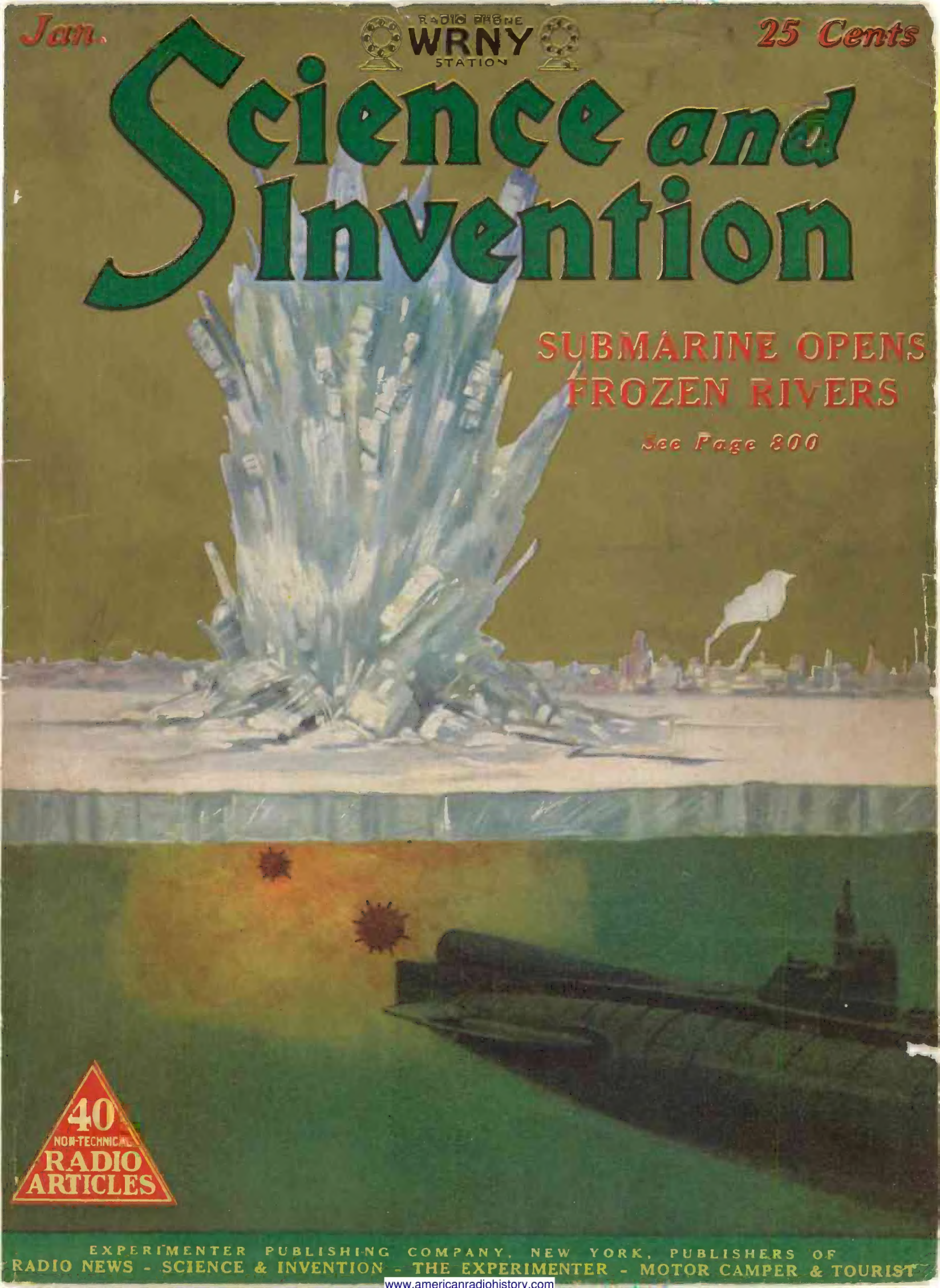

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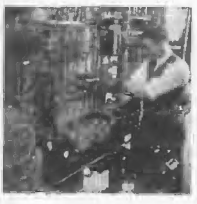

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IN OUR NEXT ISSUE

Does Tobacco Affect The Health?

An eminent German doctor gives various pertinent facts regarding the action of tobacco on the wellbeing of the smoker.

Do You Know How Ocean Liners Are Dry-Docked?

A completely illustrated article will show the entire process involved in this tremendous undertaking.

Forest Fires Detected By Light Beams

A newly developed system using a beam of light and a photo-electric cell for detecting forest fires will be dealt with in detail.

The Newest Inventions of H. Grindell Matthews

Many new developments have been made by this British scientist, reputed inventor of the so-called "death ray," and a complete article, accompanied by photographs, will present full descriptions of them.

Are You Interested In Photography?

If you are, you will find much of value in the article detailing the construction of a photo enlarger costing only $5.37 to make.

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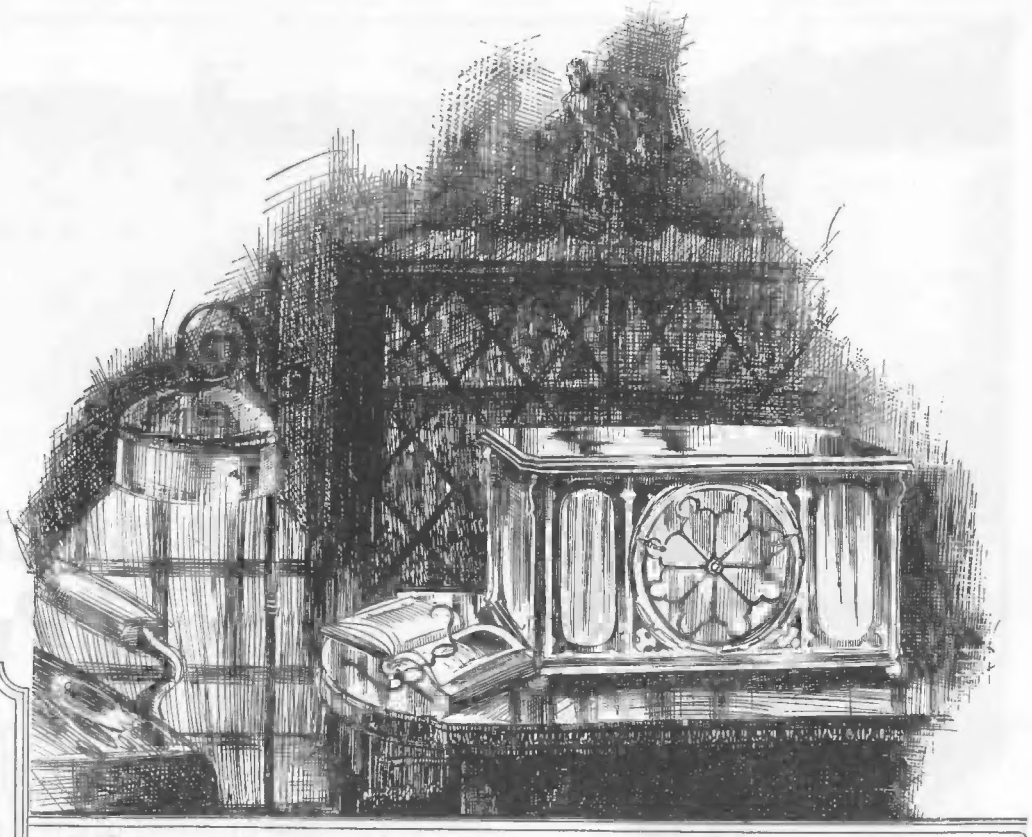

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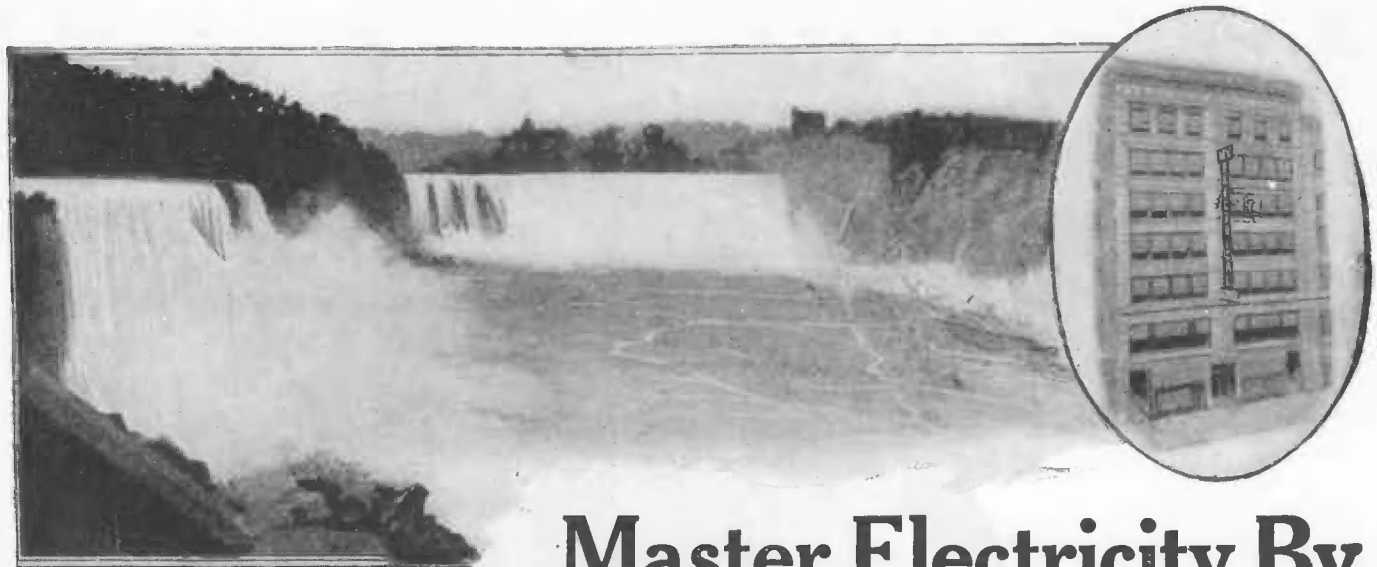

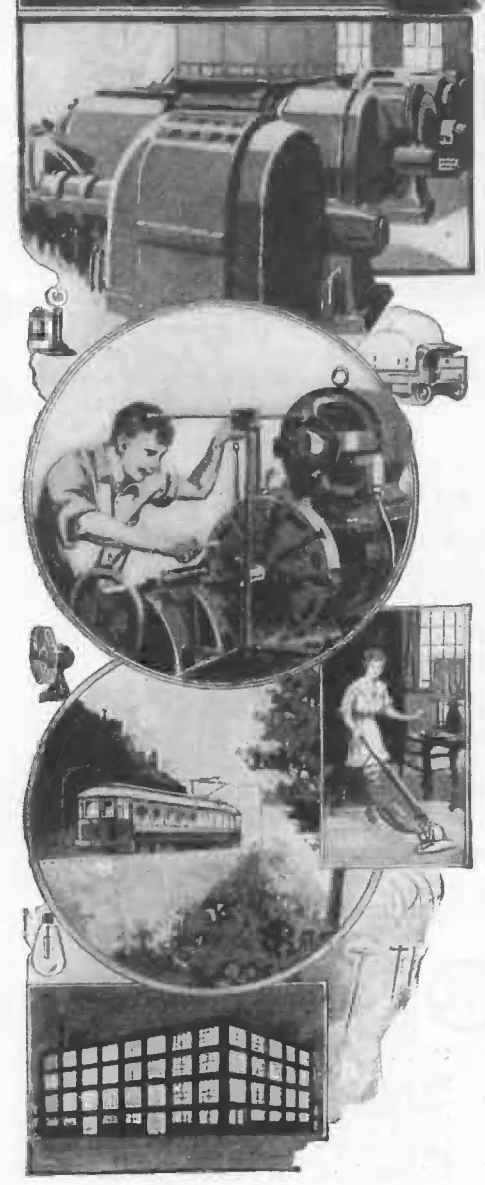

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Science and Invention

January, 1926
No. 9

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"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

SPACE

By HUGO GERNSBACK

IF there is any one subject that can bring home to us our human insignificance, as well as the insignificance of our earth, that one thing surely is space.

When we speak of space we refer to the universal, infinite space of Nature. It takes but a minute's reflection to understand that if the solar system is floating in a vast space, wherever you go, into whatever direction, there must be more space; and that if you finally come to the extreme boundaries of our universe, you can not by any possible logic have reached the ends of space, because beyond the universe there must be still more space.

The capacity of the human brain is such that it is impossible to clearly comprehend the tremendous truth behind this simple statement. Nor has the human brain the capacity to think out the infinity of space as a whole.

Just like time, which really does not exist—except in our minds—space has no end, as it has no beginning. If you were to shoot a cannon ball out into free space, and providing it were not to collide with any heavenly body, that cannon ball would roll on at its original speed, not for hundreds, not even thousands, but for billions upon billions of years; without end, without ever coming to a stop.

Either this statement is logical as far as the human mind is concerned, or else it is wrong in its entirety, and if it is then there is no infinity, as we understand the term; but space may actually be finite, and due to some complexity of the human mind we simply cannot understand the problem.

According to Einstein, space is not infinite, but, rather, circular in shape. However, there are few scientists who share Einstein's view in this respect. And the study of the heavens, as our high-powered telescopes and our sensitive photographic plates attest, reveals every so often new wonders that were not dreamt of before. Every once in a while a new star, so-called "Nova," is discovered, and by calculation it is found that such a star probably collided with another star anywhere from 1,000 to 10,000 years ago. We see the evidence of that occurrence only now, because it took the light that long to reach us, even though it travels at the rate of 186,000 miles per second.

Photography and systematic observation of the heavens have been with us but a comparatively short time. There were no photographs of the heavens taken further back than 60 or 70 years ago. Some of the stars which look permanent to us now may simply be Novae, as we know that term, on a large scale. In other words, our descendants 1,000 years hence may see a heaven totally different than that which we know now, because by that time a great many stars may have become extinguished or new ones added. In other words, many of the stars we are looking at now may have been extinct for hundreds of thousands of years, although we are still witnessing the conflagration as it took place in prehistorical times. Such are the unfathomable distances of stellar space.

We know so little about universal space at the present time that we can only venture a few remarks on the subject. We have very little idea as to the proportion of matter contained in space to space itself. Most likely, however, the matter contained in all space may be compared to it as a grain of sand compares to the ocean—the sand representing matter, the ocean, space. Yet we know that the various stars, probably in their immediate neighborhood, contain a good deal of cosmic dust, the same as the solar system contains a vast deal of such dust and matter outside of the sun's planets. We have many indications that this must be so, because in the course of ages, several planets, and perhaps many satellites, have been broken up into dust.

Our present asteroids probably constituted a planet at a date far back in the evolution of our solar system, whereas Saturn and its rings show the same thing. If there is any great amount of matter between the various universes, we have no means of knowing, nor have we even a vague idea how far the various universes float apart. The universe to which we belong includes most of the visible stars, but it is most likely that there are millions of other universes, so far removed from us, that it is impossible for light rays to bridge the gulf between these various universes.

As a matter of fact, we have no indication whether our entire universe is resting in space, or is traveling with tremendous speed to some other point in space. The reason is that there is no fixed point anywhere in space from which we could judge that we were moving or not. We now know, of course, that the solar system is moving rapidly towards some point in our own universe, but whether our own vast universe is itself moving or not it is impossible to state.

With such vast spaces to traverse, our own universe could possibly rush through space at a million miles per day without our being any the wiser. We might be rushing right into another universe, somewhere in the depths of space, and might continue doing so for millions of years without the best astronomical instruments being able to indicate such a drift.

All of which goes to show our ignorance as to space and the futility of human reasoning.

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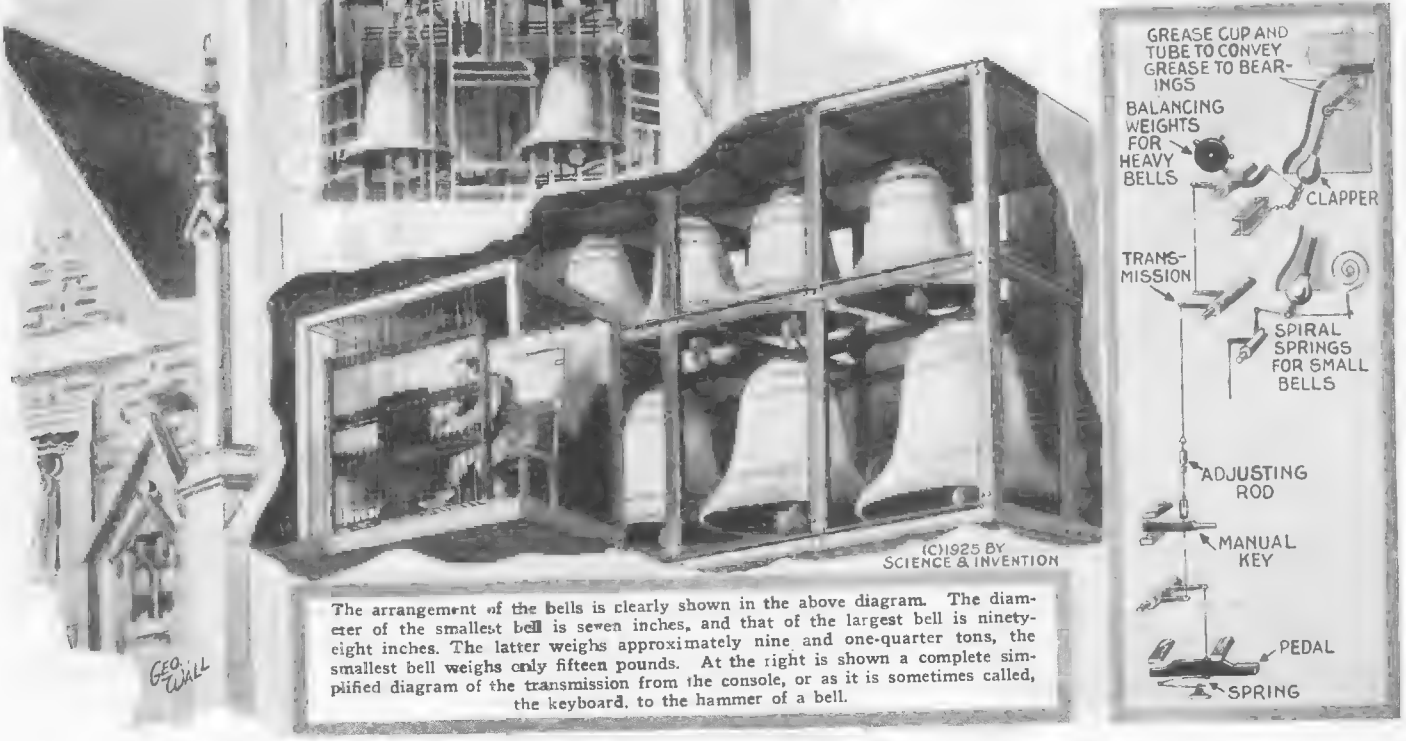
World's Largest Carillon

By J. KAY LONDON

The cutaway diagram here shows the arrangement of the bells and the position of the console for operating the bells of the largest carillon in the world. This installation is found at the Park Avenue Baptist Church and was presented by John D. Rockefeller, Jr., to this church. At the present time the chime concerts are being broadcast via radio.

ONE of the most inspiring sights which this writer has ever seen is the magnificent new carillon which has recently been installed in the Park Avenue Baptist Church in New York. This carillon is the largest both in point of number and size in the world. It contains a total of fifty-three bells covering a range of four and one-half chromatic octaves. The base bell, which corresponds with low E, in the musical scale, weighs approximately nine and one-quarter tons and measures ninety-eight inches in diameter. The hammer used on this bell is twice the diameter of the smallest bell in the carillon. This latter weighs but fifteen pounds and has a diameter of seven inches. The bells located in the tower are arranged in tiers. The interior of the church tower is only about twelve feet square and forty-five bells are hung there. A separate massive steel frame had to be built in the tower to accommodate them. In another frame the eight largest bells are installed. The hammer of each bell is connected with the console by means of rust-proof steel wires. The console resembles an old style piano. The bells at the high-

Photo above shows two of the largest bells in the carillon. Anton Brees, the Belgian carilloneur, is standing between them.



The arrangement of the bells is clearly shown in the above diagram. The diameter of the smallest bell is seven inches, and that of the largest bell is ninety-eight inches. The latter weighs approximately nine and one-quarter tons, the smallest bell weighs only fifteen pounds. At the right is shown a complete simplified diagram of the transmission from the console, or as it is sometimes called, the keyboard, to the hammer of a bell.

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er end of the chromatic scale are operated by hand only, whereas the twenty-nine lower bells may be operated by either the hands or feet. The hammers of the bells are counterbalanced by weights and the stroke of the clapper of the larger bell is about two inches.

It is not often that a visitor may see the carilloneur at work, but it must be said that this is one of the most interesting sights. One might be reminded of a cross between a boxing match and a marathon race. As the carilloneur's fingers move along the keyboard he punches out the notes striking the wooden pegs. These are connected by means of wires to the hammers of the bells. At the same time his feet stamp down upon the pedals. To hear Anton Brees playing a difficult number and to watch him operate the keyboard and the pedals is thrill enough for any good pianist. Then accompany this sight with the glorious music produced by the most perfect carillon ever built and the thrill remains to be forever impressed upon your mind.

It is claimed that these bells are tuned on the five tone principle which is said to be a rediscovered art. Three hundred years ago this method of tuning was known to bell founders of the Netherlands. Among the best examples of bells tuned by this means are those of Hemony. Then for centuries the art was lost, but after years of investigation, it was once more introduced and has now been adopted by all the British bell founders. The bells in this new carillon are accurately tuned so as to enable the carilloneur to modulate from one key to another at will without danger of consequent discords. When the base bell is struck, it continues to reverberate for fully two minutes.

This carillon was presented to the Park Avenue Baptist Church by John D. Rockefeller, Jr., in memory of his mother. Mr. Anton Brees, the Belgian carilloneur, who has played all over the world, has been engaged to play the chimes. In walking up the tower of the church one will find at the very top three fair sized bells. On a second layer there are five bells; in the third tier there are six bells, each group being progressively smaller and at the same time the bells of the group are individually smaller. Immediately under the group of six is another group of eight bells. Two of these have no springs attached to their hammers for bringing the hammers back into the striking position. The others have springs provided for the same purpose. Proceeding down further into the tower we come across two groups of bells arranged on slanting wood braces. There are eight on the upper and eleven on the lower slanting brace. These bells are nearest the openings in the Gothic structure of the church. Then looking down into the tower one sees four bells arranged as illustrated or the accompanying page, and in a campanile built especially for the purpose, the eight largest bells are arranged.

Anton Brees demonstrated to the writer how easily these bells worked and, pushing the hammer with one finger, he struck it against the bell, producing the deep characteristic tone of the chime. This showed how delicately the hammer was balanced. There is just sufficient weight in the clapper to cause it to be carried back after it strikes the bell. The bearing point of each clapper is oiled constantly by means of a copper tube connecting with an oil cup. The bells themselves are fixed to their supporting structures by means of two massive bolts passing through the top and fixed to the iron I beams. Each hammer has a safety chain.

The above photo shows a few of the bells installed in the church tower and the photo at the left shows Mr. Anton Brees at the console. There are fifty-three bells, all of which are controlled by the hands of the player. Twenty-nine of them may also be operated by the feet.

The photo at the left shows the back of a practice console. It would be impossible to practise on the carillons so this particular console is essential. Orchestral bells with resonators take the place of the giant bells of the carillon. Photo at the right shows the Park Avenue Baptist Church in the tower of which the bells are installed.

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Air Transportation Station of 1950

The uppermost section of this transportation terminal, which may become a reality within a few decades, is devoted to landing platforms for aircraft as well as to freight and baggage compartments and waiting rooms for passengers. Below this section are living apartments accessible by elevators or by automobiles ascending on spiral roadways. Underground are the railroad tracks together with the usual stations and waiting rooms. The airplane terminals are plainly numbered and designated by lighting arrangements to aid incoming aircraft.—Reclam's Universum.

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Unsinkable Ship Actually Built

The large illustration at the right shows essential details of a non-sinkable ship that incorporates many new and novel features. Recent bad weather on the Atlantic has brought forward the idea of unsubmersible ships. In the one illustrated, a six-inch air space within the skin or outer plating is the leading feature. Vacant spaces in the hold are filled with air-tight buoyancy chambers.

Small illustrations at right above show buoyancy chambers.

THERE have been numerous patents issued, especially during the war, on practically every conceivable kind of unsinkable ship, but it is safe to say that none of these have ever been tried out on anything larger than a small scale model, if they were even carried that far. The exception is the scheme here illustrated and described and which is due to Mr. William T. Donnelly, of New York, the well-known designer and builder of large floating drydocks. Mr. Donnelly was a member during the war of the Governmental Committee appointed to consider all of the various ideas and suggestions for rendering ships unsinkable. This was one of our greatest problems, if not the greatest, during the World War, when the German U-boats were sinking ships daily.

This scheme of Mr. Donnelly's is simple and the best thing about his idea is that it was actually tried out on a number of vessels, including a full-sized steamship. This method of rendering a ship unsinkable was actually carried out during the war, and a vessel so equipped traveled across the Atlantic Ocean to Europe. This ship was torpedoed, but the reason why it did not live to tell the tale is explained a little later on.

The underlying idea behind the design of the unsinkable ship we have in mind here is that if we provided an air buoyancy space or chamber all around the ship and also in the principal spaces within the ship's hold, which are not occupied by cargo, the ship will float even if the sea-cocks are opened, as an actual test of this nature proved.

In other words, if the steel plates on the vessel's hull were one inch thick, and we provided a seven- or eight-inch air space all around the inside of the steel hull, the weight of the steel would be balanced, and ignoring the weight of water which might be taken into the hold if it were empty, the vessel would float. Instead of one great compartment of double-skin construction, air buoyancy chambers may be built up in various ways to do the same work, and in the ship fitted out according to this scheme, such chambers were made of wood covered with sheet iron with soldered joints to render them air- and water-tight. The buoyancy chambers are anchored in place, of course, wherever necessary and are placed under the decks in unoccupied spaces in the holds and in other sections of the ship so that they can exert an upward lifting effort against the substantial deck girders and buoy up the vessel.

The illustration given here shows the general method of applying the principle described above, and gives a clear idea of the ship so fitted. The reason why the ship equipped with the air chamber method here outlined sank, when torpedoed in its engine room section, on its way across the Atlantic near the close of the war, was ascertained by the inventor when he saw the manifest indicating how the ship was loaded. Extra heavy cargo was on board and the spaces left in the hold were not filled with buoyancy chambers. The result was that when the water came into the hold its weight overcame the buoyancy of the ship, with insufficient salvage chambers, and it eventually went down, but only after being afloat for 23 hours.

Contrary to an off-hand impression, perhaps, that the normal cargo storage space on the ship would be greatly reduced by the use of the buoyancy chambers, the cargo space was only reduced about 15 per cent.

Why are not more experiments carried out with such humanitarian inventions such as this, the reader will ask, and the answer is that it is very difficult, as the inventor has found, to get shipbuilders to try out these ideas. Furthermore, the big marine insurance companies have no desire to see any such invention as this come into the field of ocean transport, for when once it has been proven successful and is adopted by the large ship operating and building companies, the the rates for insurance on ships and cargoes will be greatly reduced.

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Bridging the English Channel

NO longer need swimmers brave the treacherous tides of the English Channel or those with squeamish stomachs fear sea sickness when crossing that stretch of water if the dream of M. Jules Jaeger, a Swiss engineer, materializes. It is that inventor's plan to bridge the channel and then one can walk across if he feels so disposed. The illustrations on this page show our artist's conception of how such a proposition would appear when completed. It is estimated that this undertaking would cost between $350,000,000 and $400,000,000. In the plans, all kinds of traffic have been provided for. Two motor causeways situated 1,000 feet apart provide for motor traffic and directly under this, tracks are to be laid for trains. Ocean liners can proceed up and down the channel, passing under bridges situated near both shores. The circular insert shows a cross-sectional detail of the motor causeway, railway track and jetty. The map in the lower left-hand corner shows the proposed location for this bridge. In case of necessity due to war time emergencies, either end of this important traffic link could be immediately destroyed. A bridge of this nature would be of inestimable value to both England and France, from a commercial viewpoint; and furthermore would provide a protected waterway between these two countries along which barges and other inland water craft could travel.

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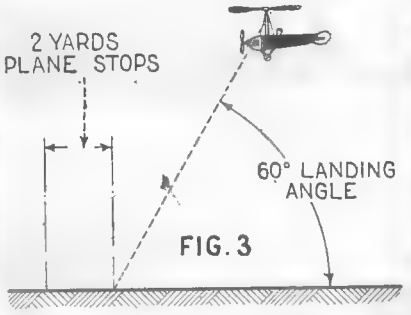
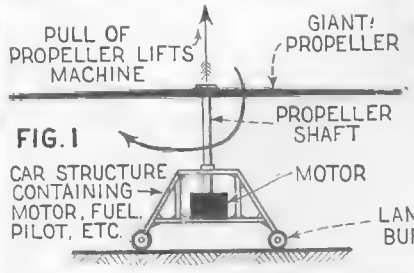
New Helicopter-Airplane

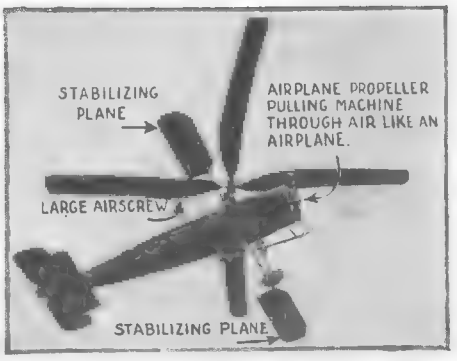
By C. A. OLDROYD

Aeronautical Engineer; Reporter No. 4433 (English Correspondent)

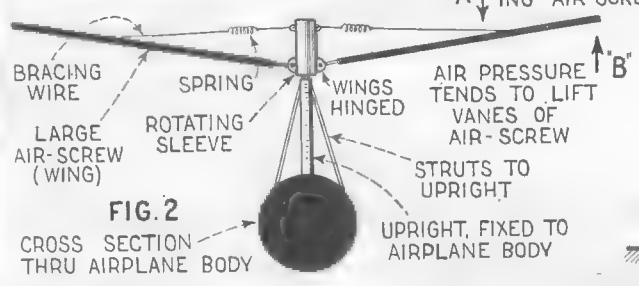
An artist's conception of the new helicopter in flight over New York City. A machine of this kind could land on ordinary flat building tops, as no special landing fields are required.







Above: Actual photograph of auto-gyro in flight. Important features indicated.



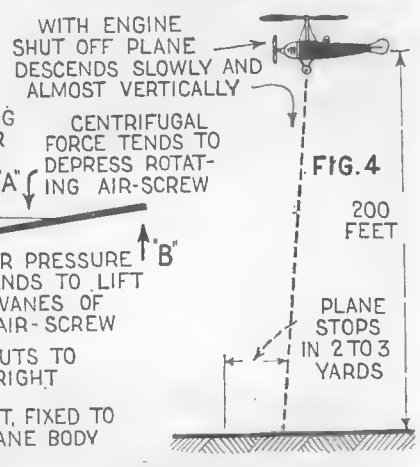

WITH ENGINE SHUT OFF PLANE DESCENDS SLOWLY AND ALMOST VERTICALLY
CENTRIFUGAL FORCE TENDS TO DEPRESS ROTATING AIR-SCREW
"A"
FIG. 4
200 FEET
PLANE STOPS IN 2 TO 3 YARDS

Fig. 1. A standard helicopter. Fig. 2. A diagramatical view of the auto-gyro showing location and general principle of the airscrew, which allows vertical flight. Figs. 3 and 4 show two methods of landing with auto-gyro.

A SPANISH engineer, Señor de la Cierva, has at last given to the world what appears to be the perfect flying machine. Recent tests carried out in England by the Air Ministry of Great Britain show beyond doubt that the new machine fulfills all demands that can be reasonably made on any flying machine.

We all have some time or other built flying machines, for the kite is really the simplest type of aerial machine. The surface of the kite is at an angle to the wind direction, and the air pressure produced by the wind lifts the kite. The air pressure is opposed by the pull of the kite cord, so that the kite cannot drift away with the wind, but is forced to rise. Stability to the whole is given by a long tail.

The airplane is based on the same principle, only here the kite cord is replaced by the pull of the propeller. The propeller draws the machine through the air, and the pressure against the wings lifts the machine upward. Fixed tail surfaces serve the same purpose as the feathers at the end of an arrow, they maintain the machine in straight flight. By means of rudders and elevators, the pilot can direct the flight of the machine.

And, finally, we have the helicopter. One type is illustrated in Fig. 1. The lifting action is produced by a giant airscrew mounted above the structure that serves as landing chassis and car. As the motor turns the propeller, the machine lifts off the ground, and from now onward flies by hanging from the lifting airscrew.

Stability is therefore most difficult to attain with a machine of this type, for the wind currents interfere most seriously with the air currents around the lifting airscrew. None of the true helicopters yet constructed can be called entirely successful, and it is doubtful whether the world will ever see a thoroughly satisfactory machine of this type.

The greatest drawback of the helicopter is that engine failure spells a crash, resulting in a more or less complete wreck of the machine.

The new auto-gyro flying machine combines the advantages of the airplane and the airship, without possessing any of their drawbacks. It is small and compact like the airplane, and capable of high speed with low power. In addition, however, it can land in the smallest space, and as the latest experiments made prove, it can even descend vertically.

The photo shows the experimental machine in flight. This has been constructed from a standard airplane after the original wings had been removed. Just behind the pilot's cockpit an upright steel tube has been fitted, on which the large horizontal airscrew, the essential feature of this machine, is supported. Short steel tube stays to the side of the airplane body hold the upright rigid.

This airscrew is, however, not power-driven, as in a helicopter, *but revolves freely on its axis as the machine travels through the air.* The airscrew consists of four light, narrow wings, each seventeen feet in length; at the root, these wings are hinged to a rotating sleeve which goes over the steel upright. (Fig. 5.) The wings are supported by bracing wires; between the end of these wires and the sleeve strong springs are inserted.

Before discussing the action of the large airscrew, let us follow the various stages of flight of this new auto-gyro. Before the pilot can take off, the large airscrew must be started. In the experimental machine shown in the pictures, no provision has been made to start the airscrew by power, so it must be done by hand. A rope is wound a few times around the rotating sleeve, and several men pull, causing the large airscrew to rotate slowly on its ball-bearing sleeve.

The engine of the machine, which drives the front propeller, is now started, and the pilot takes off. We notice that the large horizontal airscrew turns faster and faster as the machine runs over the ground; when a speed of about 120 revolutions per minute has been reached, the large airscrew can support the whole weight of the auto-gyro.

Flight is now controlled in the usual manner by means of rudders and elevators. The pilot now makes a landing, and a very sudden one, too, for the machine descends at an angle of about 60 degrees to the horizontal. The landing wheels touch the ground, and in only two yards the auto-gyro comes to a dead stop! No airplane could possibly perform a similar feat.

But the pilot has some more surprises in store for us, he ascends again, and when he has reached a height of about 200 feet, he cuts off his engine. An airplane would glide down to the ground, not so with the auto-gyro. The large airscrew above the body continues to rotate slowly, and the auto-gyro sinks down slowly to the earth, descending almost vertically. Without any severe shock, the landing wheels touch the ground, and again the machine comes to rest within a yard or two.

(*Continued on page* 876)

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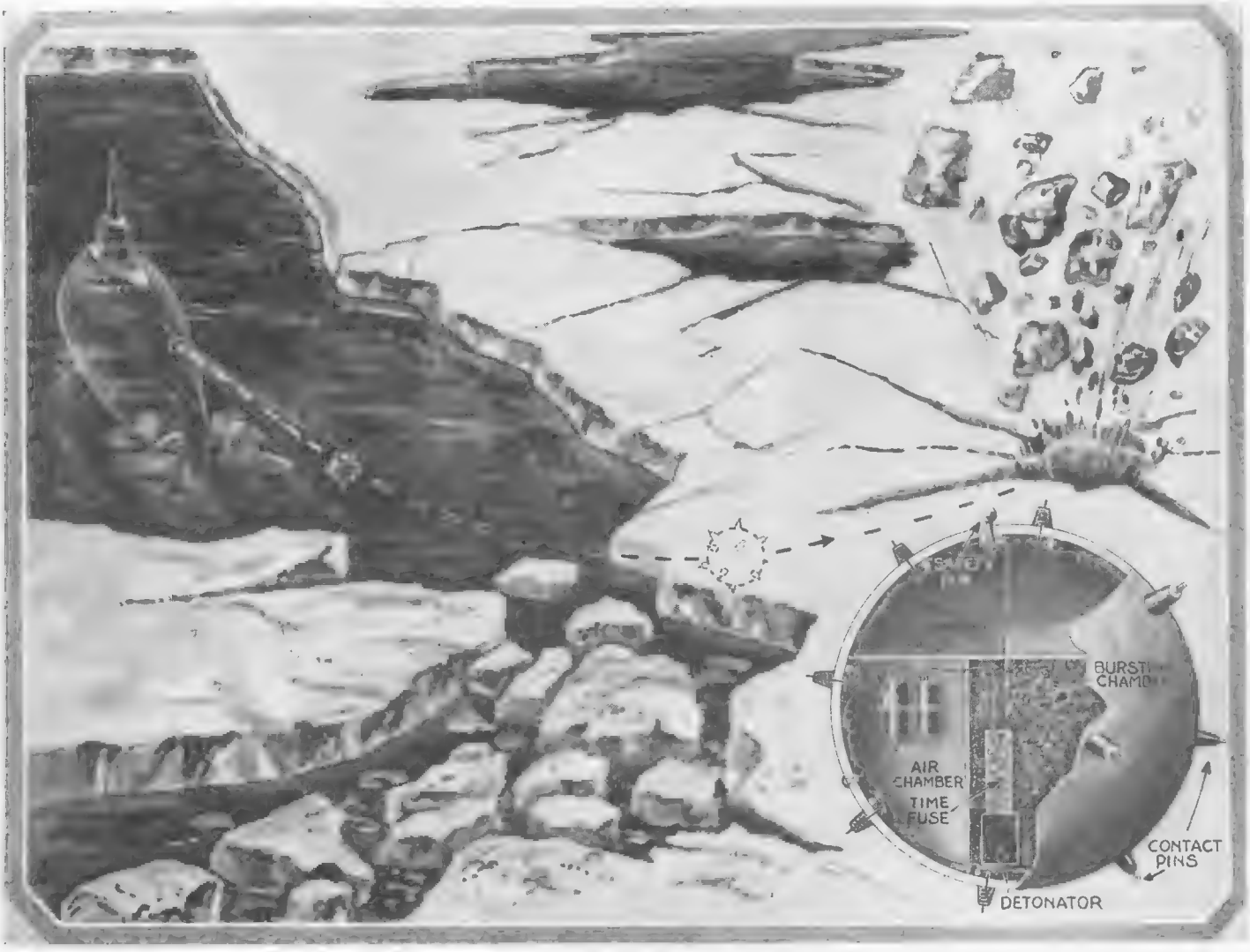
Submarine Opens Frozen Rivers

By JOSEPH H. KRAUS



The above illustration is an artist's conception of the proposed method of opening navigation in rivers which are frozen over during cold winters. The drawing further illustrates the particular style of bomb, liberated by submarines, which could be employed for blasting away the ice formations.

MANY attempts have frequently been made to open river navigation, which, due to severe weather, may be frozen up for a good part of the winter season. Tug boats have attempted to crash through the ice and even the planting of dynamite charges has been resorted to. There are many obstacles to be overcome in those methods now in vogue and no doubt there will be objections to the particular method here outlined, but it seems that this idea has fewer disagreeable features than any of the systems heretofore suggested.

Let us look into the method of planting dynamite charges in the frozen ice. Here men must place the charges by hand and either time fuses or electric fuses are employed to detonate the dynamite. In event that the ice is partly hard and soft in spots, or not frozen at all, over certain areas, due, perhaps, to turbulent waters, the person placing the charges risks his life constantly.

Tug boats cannot possibly break through very heavy ice formations in a short space of time, and thousands of dollars are lost yearly because river navigation cannot be opened soon enough to prevent perishables and live stock from suffering because of their non-delivery.

The airplane has been tried and, for several reasons, it is unsuited for this particular kind of work. First, the charges dropped from the airplane are invariably scattered over large areas. During very inclement weather it is dangerous to risk the life of the aviator, and the airplane itself cannot carry a sufficient number of bombs to permit of thorough work over large areas.

For these reasons it has been suggested that the submarine be used to overcome the difficulties under which the other systems must operate. The inventor believes that if the submarines were equipped with bombs suitably provided with air chambers so that they would float to the surface, and contained a charge of high explosive, many of the drawbacks would be overcome. These bombs are made as shown in the illustration above. There is a series of contact pins located aound the periphery of the bomb which, on coming in contact with the ice, close the circuit through the batteries and ignite the time fuse. This time fuse is so regulated that the submarine has plenty of opportunity to get out of the way of the bursting bomb. Water being practically incompressible, it may be readily noted that the force of the explosion just beneath the surface of the ice would break up the ice formation in a manner second to none. Even the fact that the bomb may come up to the surface in an area where there is no ice, has been taken into consideration. When the safety pin is withdrawn there is an opening leading directly into the air chamber. This opening is located beneath the waterline of the bomb, which, because of the peculiar formation of the air chamber, must always come up to the surface in an upright position. The opening is large enough to permit water to pour into the air chamber so that two or three minutes after the bomb is released, if it does not explode on the surface, it sinks to the bottom and there detonates. It is better to have the bomb destroyed in this manner than to permit it to float around as a menace to navigation.

The location of the submarine could be always corrected by means of the radio compass and by means of sound rangings. In this way, the submerged vessel would never be in danger of striking any vessels frozen fast in the ice and it could also be directed through tortuous rivers and dangerous channels.

Keep your eyes open for the February issue of SCIENCE AND INVENTION magazine containing the list of prize winners in our recent CLOCK SPRING Contest. The judges are still busy in selecting the prize winning ideas and their decisions will be published in the next issue. Also, don't forget the $5,000.00 Matchcraft Contest. Further information concerning this will be found on page 819.

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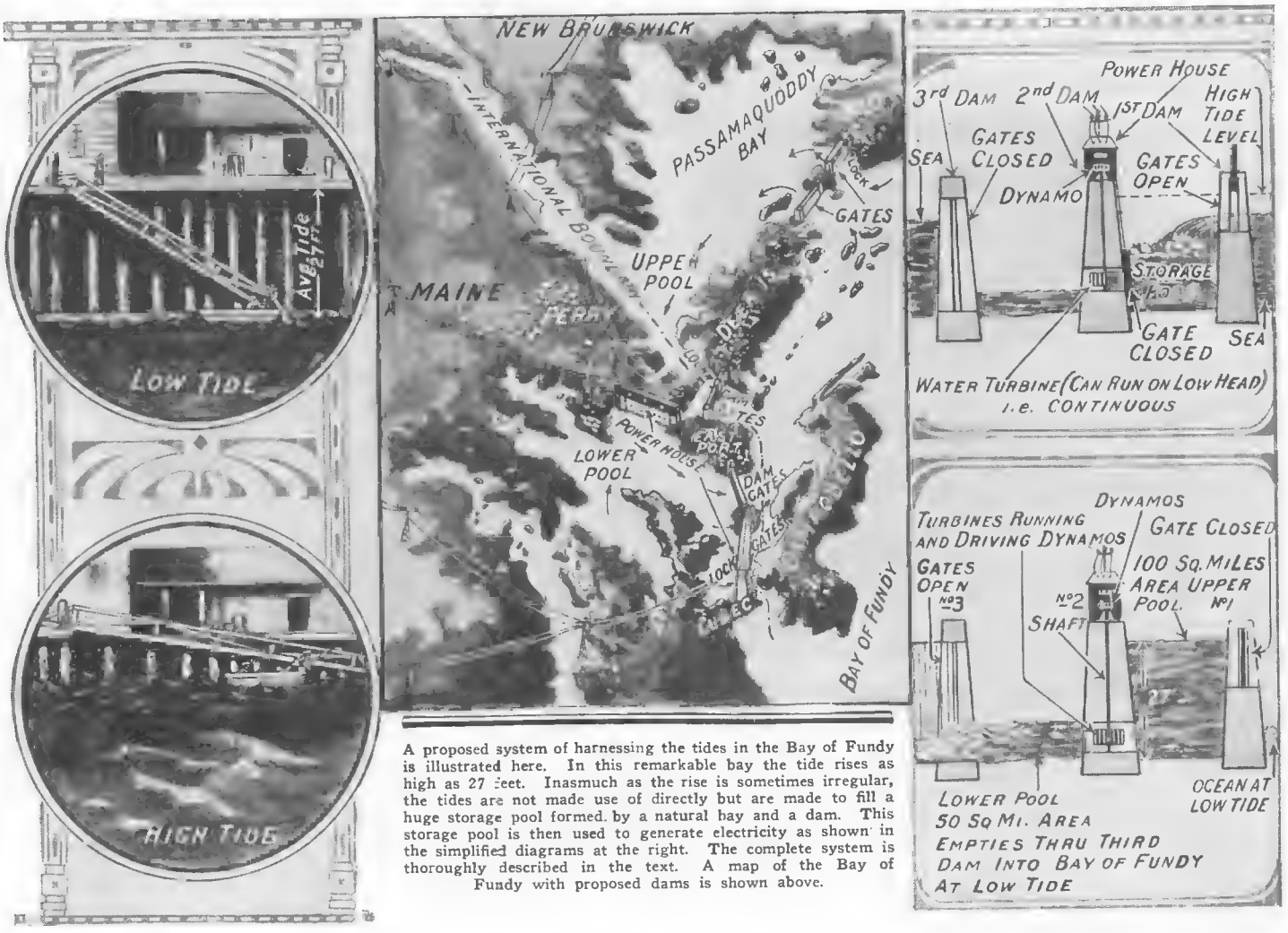
Harnessing Bay of Fundy's Tides



A proposed system of harnessing the tides in the Bay of Fundy is illustrated here. In this remarkable bay the tide rises as high as 27 feet. Inasmuch as the rise is sometimes irregular, the tides are not made use of directly but are made to fill a huge storage pool formed by a natural bay and a dam. This storage pool is then used to generate electricity as shown in the simplified diagrams at the right. The complete system is thoroughly described in the text. A map of the Bay of Fundy with proposed dams is shown above.

TIDAL power has been the dream of many engineers, but so far practically none of this vast natural power has been applied for the benefit of man. Possibly one of the reasons why engineers and their financial backers have hesitated to build the necessary storage reservoirs or basins in which to trap water at high tide, this being one of the principal features of the methods advocated, is due to the fact that, except for a few locations on the earth, the tidal rise and fall is not so great as it is, for instance, at the Bay of Fundy, just off the northeast coast of Maine. Startling as it may seem to those who have not seen this daily rise and fall of the waters, the tide at this famous location rises and falls from 21 to 27 feet twice a day.

Mr. Dexter P. Cooper, a leading American hydraulic engineer, has become so interested in the possibilities of harnessing these great tides of the Bay of Fundy, that he finally got the whole state of Maine interested also, with the result that, within the next few years, we may see one of the greatest water power developments at this point that the world has yet witnessed.

GREATER THAN MUSCLE SHOALS

The possibilities for power development at the Bay of Fundy location are considerably greater than at the famous Muscle Shoals power dam. In a recent interview with Mr. Cooper, he said that the greatest possible development at Wilson Dam, Muscle Shoals, is 700,000,000 kilowatt hours a year, while at the Bay of Fundy the amount of continuous dependable power will be at the rate of 3,268,000,000 kilowatt hours a year. In other words, the Bay of Fundy scheme has latent power possibilities four times greater than those of the Wilson Dam plant.

Comparing the Muscle Shoals plant with the proposed Bay of Fundy development, it is interesting to note that when the Tennessee River is full, this plant will develop 600,000 horse-power, and only 100,000 horse-power when the river is low; the Bay of Fundy power site will, it is estimated, provide at least 500,000 horse-power steadily. Engineer Cooper states further that eventually the power developed can be increased to 700,000 horse-power, sufficient to supply all New England and more.

AREA OF RESERVOIRS 150 SQ. MI.

The accompanying sectional diagrams and map show the simplicity of this scheme for harnessing the tides of the Bay of Fundy. The storage reservoirs are divided into lower and upper pools. The upper pool or main storage reservoir will have an area of approximately 100 square miles, and the lower pool one of about 50 square miles. The gates of the upper storage reservoir will be opened as the tide rises and a vast amount of water will be thus impounded from the sea. At maximum high tide and when the water level inside the upper storage reservoir is the same as that outside the gates, they will be closed. Water will be released practically continuously, according to Mr. Cooper's plans, through the power house dam and water turbines into the lower pool. Water from the lower pool will be emptied back into the sea at low tide by opening the gates in the third dam, as the diagrams show. It will be seen that if it was not for this third dam the tide would fill the smaller or lower basin at the same time and to the same level as the upper basin, and thus the turbines could not operate until the tide had fallen to its lowest point again, or nearly so.

Thus it will be seen that Mr. Cooper has very ingeniously worked out his proposed development for exploiting the tides of the Bay of Fundy, for by utilizing the two basins and the three dams, he is able to operate his water turbines and dynamos 24 hours a day if he so desires. The dam at the mouth of the upper pool will have to be about 4,000 feet, nearly a mile, in length, and 70 feet in height. This great wall will contain 33 massive gates. The opening from the lower pool to the sea will have to be closed by a dam about half a mile long, provided with an adequate number of gates, which will be operated as aforementioned and as shown by the diagrams. The intermediate power house dam, separating the upper and lower pools, will be about 3,600 feet in length. Power houses will be built on the dam.

Mr. Cooper estimates that it will require a regiment of men, or about 5,000, working over a period of five years to construct the huge dams and gates. The monetary cost of this huge operation would run up to about $75,000,000. One of the problems the engineers had to figure on was the fact that the state of Maine has a law prohibiting the

(*Continued on page* 873)

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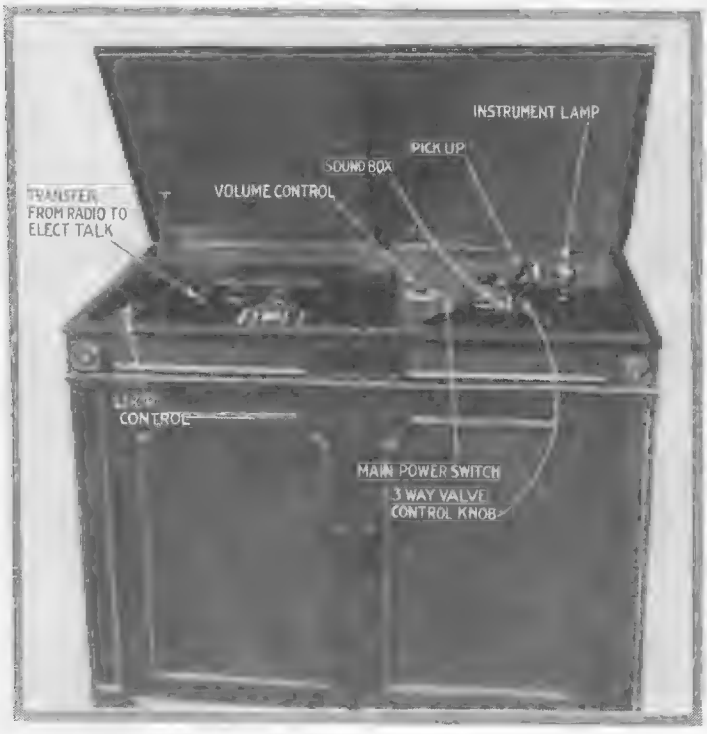
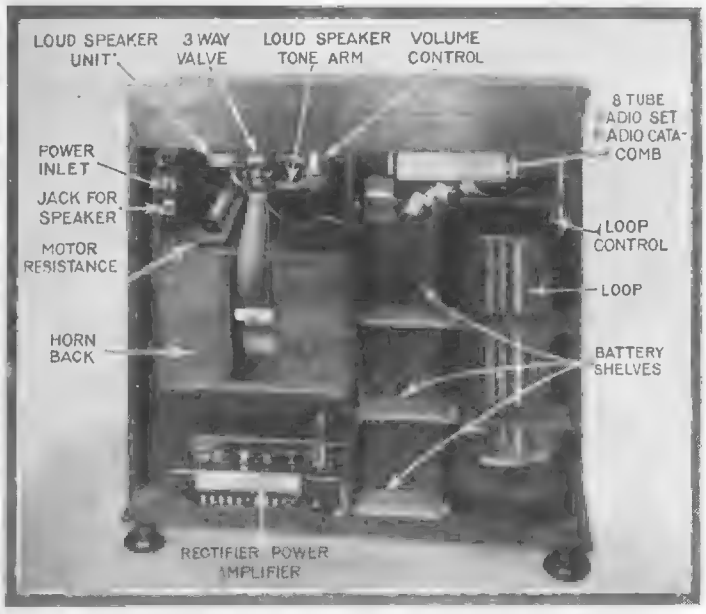
Orthophonic Radio Phonograph

A Remarkable Combination Talking Machine and Radio Receiving Set, Which Gives Perfect Voice Reproduction with Full Volume of Original Voice, Band or Orchestra.

By H. Winfield Secor, E. E.





Photographs at the left and right show the front and rear views respectively of the orthophonic radio phonograph. All of the component parts are plainly labeled and by reading the text, you will learn all about this wonderful new development in the radio and phonograph field.

THIS seems to be an epochal year in the realm of radio and phonograph development. A short time ago we described a wonderful new talking machine known as the *panatrope*, in which the full volume of the original orchestra, band, organ or voice is reproduced by means of an electrical pick-up traveling over the record, together with the aid of a vacuum tube amplifier. The electrical output from this amplifier is then carried into a new cone loud speaker developed by the General Electrical Company engineers and the results obtained with this clever combination of new scientific ideas are fully described in the November issue of this journal.

A short time ago the writer was present at a demonstration of the latest brain child of the Western Electric Company and Victor Talking Machine Company engineers, and he was very agreeably surprised at the faithful reproduction, as well as the volume of the vocal and instrumental selections on the new orthophonic talking machine.

THE ORTHOPHONIC SOUND BOX

The two most important factors involved in the orthophonic phonograph lie first in the new folded type of horn as it is called, and which is shown in the accompanying photographs and special drawings; and secondly, in the sound box and its diaphragm. The majority of talking machine sound boxes or reproducers which pick up mechanical vibrations from the record and translate them into sound waves which are projected downward and out of the horn, have used mica diaphragms. A number of other materials have been tried from time to time, but the old stand-by has been mica. As good as this material has proven for many years in its utilization for sound box diaphragms, it was limited in the range of vibrations which it could cover, namely, about 350 to 3,000 a second, or about three octaves on the musical scale. This means that the very low as well as the very high vibrations were never heard at all on the old style talking machine. This also holds true for all of the average type radio loud speakers.

Extended research work in the acoustical laboratories of the American Telephone and Telegraph Company and the Western Electric Company, together with the aid of the Victor Talking Machine Company experts, brought out the fact that the best of all materials for a sound box diaphragm was duralumin, now widely used for airplane construction. This new material when tried in the form of a diaphragm of the proper shape, proved that it could respond to sound frequencies over 5½ octaves, or from about 100 up to 5,000 vibrations per second, which covers practically the whole scale of speech or music, so far as the human ear is concerned. Mica diaphragms also had the undesirable property of vibrating in sympathy

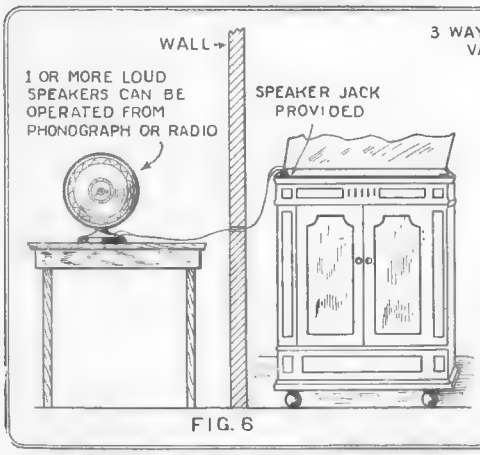


FIG. 6

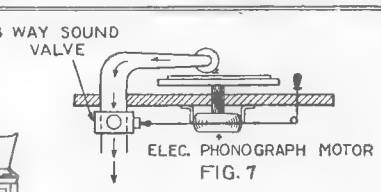


FIG. 7

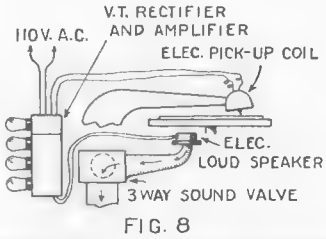


FIG. 8

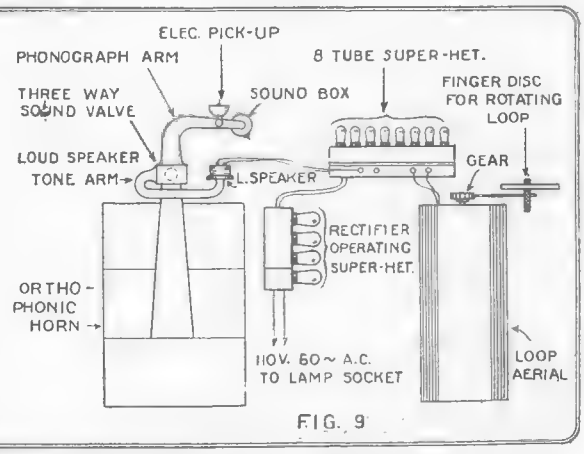


FIG. 9

Fig. 6 shows that several loud speakers can be used with this new combination phonograph and radio set so as to reproduce the sound in any part of the house. Fig. 7 shows operation with standard phonograph reproducer and Fig. 8, with electric pick-up coil, through amplifier and to loud speaker, result being tremendous volume. Fig. 9 shows component parts being used for the reproduction of incoming radio signals.

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with certain musical notes. The new orthophonic sound box has a diaphragm which is corrugated or ridged in a certain fashion in order to give it rigidity and also to prevent any sympathetic vibrations which the diaphragm might try to assume. This new sound box is claimed to obviate all *blasting*, which is common to many radio loud speakers and phonographs of the ordinary type.

THE ORTHOPHONE HORN

Taking up the new orthophonic phonograph in a general way, we find that the larger size machine costing a little under $300.00 has a massive folded wooden horn within it, the length of the sound path through this horn being six feet or seventy-two inches—some horn you will agree.

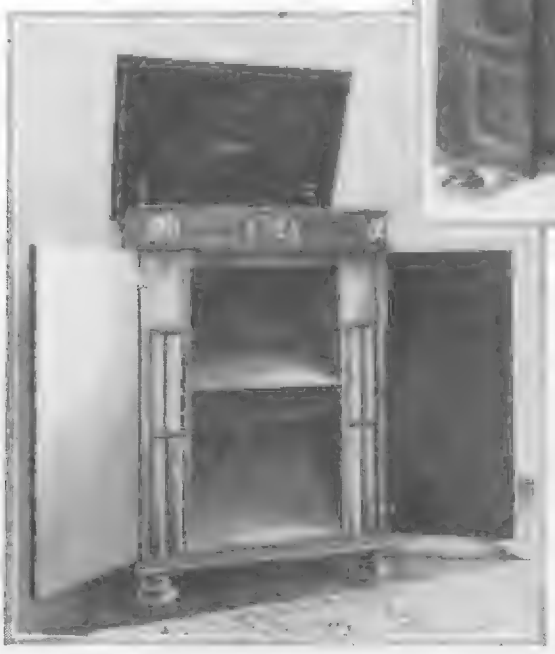
One of the accompanying diagrams show the length of the average sound wave in air corresponding to, let us say, a baritone note. The sound wave here shown in connection with one of the new horns is six feet, but even a 4½ foot horn, corresponding to a 4½ sound wave in air will give very wonderful reproduction on the lower notes of the musical scale, as was pointed out to the writer several years ago by Professor Dayton C. Miller, of the Case School of Applied Science, who is one of our leading acoustical experts.

It will be seen from the accompanying diagram of the six foot sound wave and the long horn which is needed to allow this sound wave to vibrate or resonate with full power, that a small phonograph or loud speaker horn about one to 1½ feet long can only reproduce these low notes by resonating harmonics or partial tones of the fundamental note. In some cases it is possible to get fair results by building up certain harmonics of the fundamental note, but it is not the preferred method by any means.

Another important scientific point which phonograph manufacturers have constantly ignored for years is a fact which acoustical experts have always known, which is that there should be no air leaks or right angle bends along the sound amplifying passage. Also, the walls of the horn should be rigid —only the air column should vibrate. In the orthophonic talking machine this was one of the points particularly watched, and it was interesting to note in regard to air leaks how the tone arm had been redesigned so as to be practically air-tight at its base, where it joined the orthophonic amplifying horn; secondly, the sound passageway through the tone arm was designed to continually expand, without having any abrupt right-angle bends. With many of the old style tone arms, the sound waves coming from the reproducer diaphragm only traveled a few inches, when they were reflected sharply by a right-angle bend at a joint in the center of the tone arm. These reflected sound waves or echoes created blasting, and also caused many of the finer notes to be weakened or entirely destroyed by the time the music or speech emerged from the opening of the sound chamber or horn.

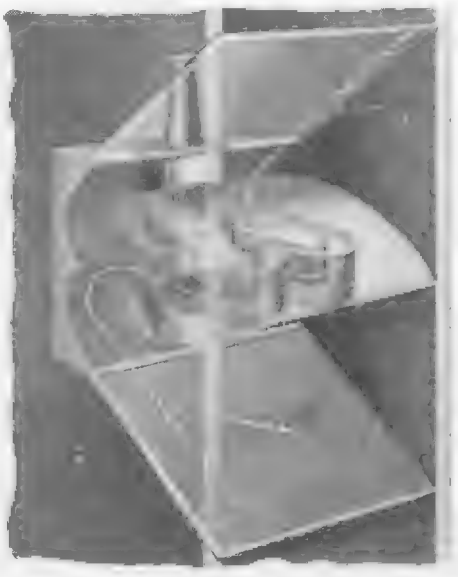
One of the men familiar with the experiments carried on in the laboratory in developing the new orthophonic horn said that while a six foot horn might seem long to the layman, the ultimate in sound reproduction would be obtained by means of a horn twenty feet in length. One of these days we probably will be buying phonographs with twenty feet of horn folded or spirally concentrated within its case, but the phonograph experts tell us that the new six foot horn reproduces and builds up practically all of the main vibrations over the 5½ octave scale, so necessary for first-class vocal and instrumental sound reproduction.

(*Continued on page* 875)



Photographs above and at the left show the beautiful cabinet in which this new combined radio and phonograph is housed. In the view at the left, the front screen has been removed so as to show the horn openings.

The phantom view at the right shows the construction of the folded horn which gives a resonating chamber 6 feet long yet is all contained within the cabinet. The dotted lines show in general the paths of the sound waves but it must be remembered that the sounds issue from both left and right of the top and bottom openings.



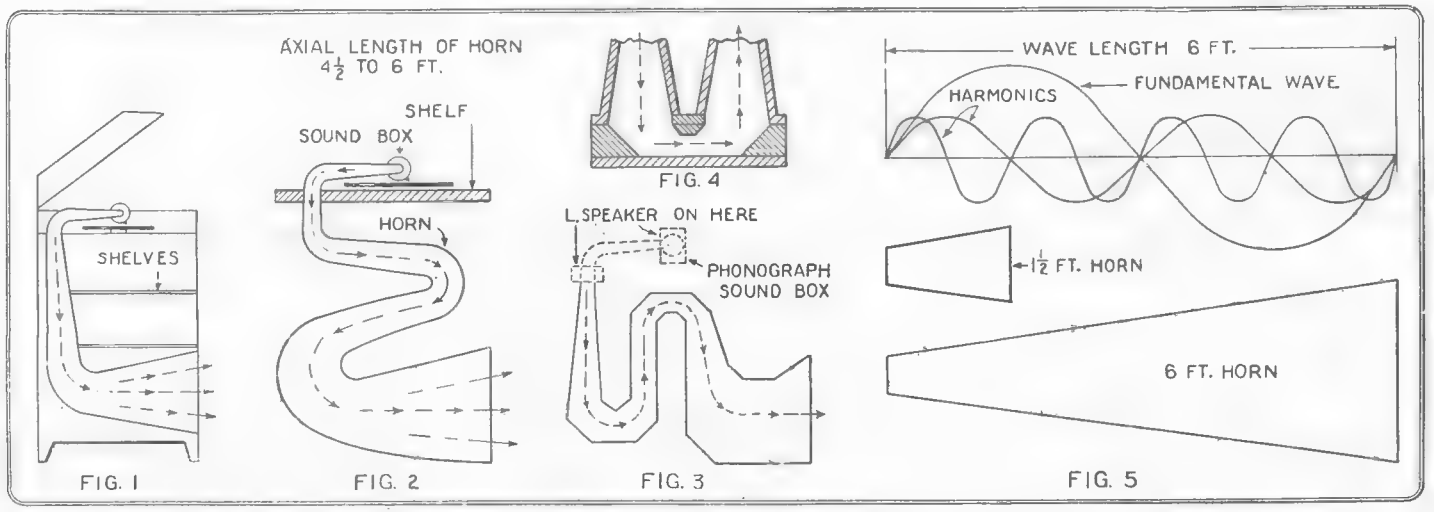


Fig. 1 shows standard phonograph with ordinary horn and Fig. 2 indicates how larger resonating chamber can be obtained. Figs. 3 and 4 give constructional hints for building horns of this nature for your own use on present phonograph or radio loud speaker. Fig. 5 shows how short horn will respond only to harmonics of certain wave-lengths whereas a horn of the same length as the wave responds to full wave.

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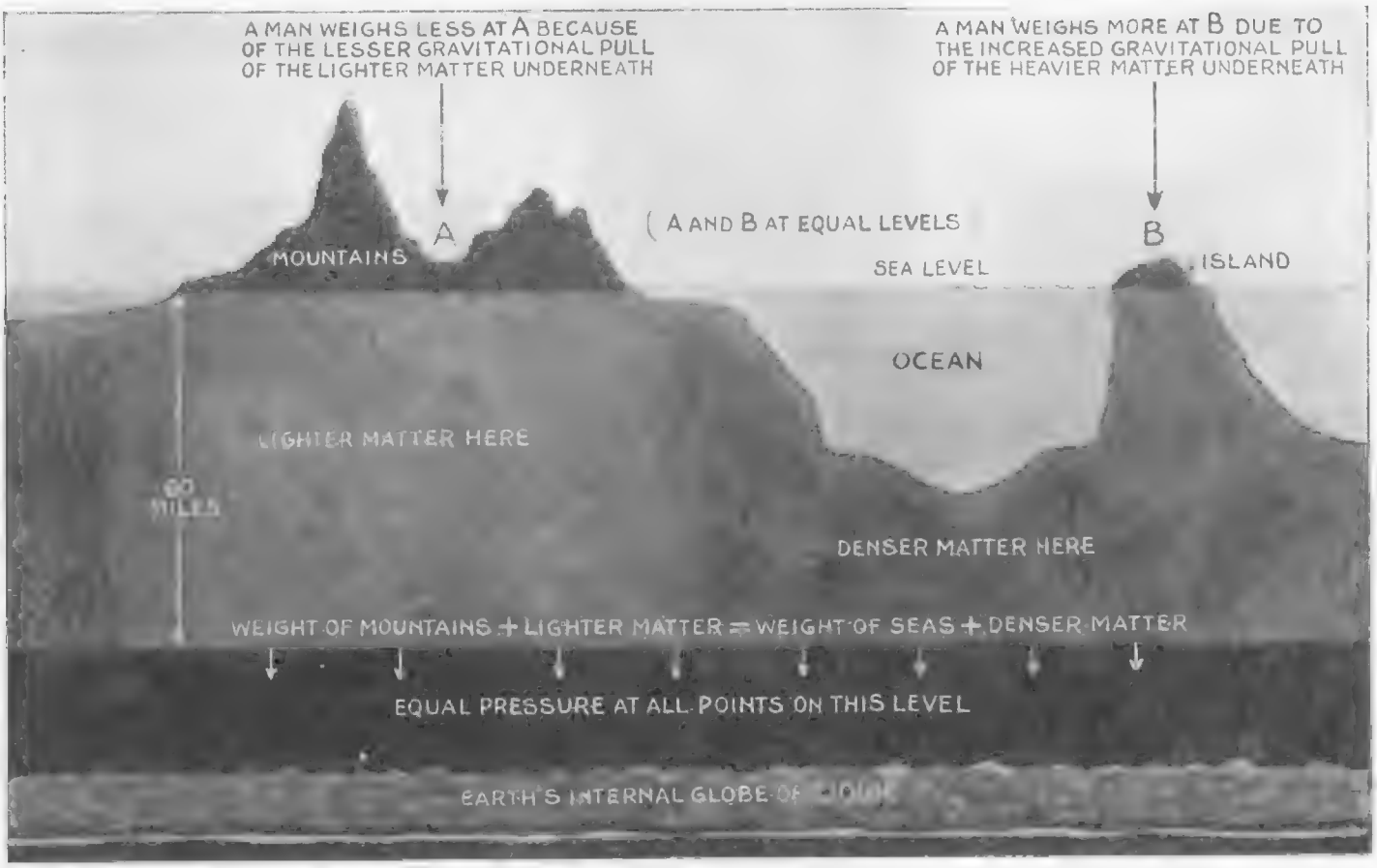
You Weigh Most on Ocean Island

There Are Several Things Governing the Weight of Bodies on the Earth's Surface and They Are Revealed in This Informative Article.

By Ernest Brennecke, Jr.


A MAN WEIGHS LESS AT A BECAUSE OF THE LESSER GRAVITATIONAL PULL OF THE LIGHTER MATTER UNDERNEATH
A MAN WEIGHS MORE AT B DUE TO THE INCREASED GRAVITATIONAL PULL OF THE HEAVIER MATTER UNDERNEATH
A
B
(A AND B AT EQUAL LEVELS
MOUNTAINS
SEA LEVEL
ISLAND
OCEAN
LIGHTER MATTER HERE
60 MILES
DENSER MATTER HERE
WEIGHT OF MOUNTAINS + LIGHTER MATTER = WEIGHT OF SEAS + DENSER MATTER
EQUAL PRESSURE AT ALL POINTS ON THIS LEVEL
EARTH'S INTERNAL GLOBE OF

The cross-section of a portion of the earth's surface shown above will assist the reader in understanding the explanatory paragraphs in the article below, wherein it is explained why a man on an ocean island, as at B, weighs more than one at an equal altitude, in the location at A.

A CURIOUS fact was brought to light recently by Prof. Horace Lamb, the distinguished mathematician and President of the British Association for the Advancement of Science, in his inaugural address before that body. It is generally known that as we climb up above the sea-level our bodies weigh less and less, due to decreased gravitational pull as we increase the distance between ourselves and the center of the earth.

What is not so familiar is the later discovery that even at equal altitudes above sea-level a man will weigh more if he is standing on an island in the ocean (Hawaii, for instance) than he will weigh if he stands in mountainous inland country (at Albany, N. Y., for instance, between the Catskill and Adirondack Mountains.)

Of course the difference in weight is very slight; but it has now been established by repeated experiments of great delicacy, carried on chiefly by the U. S. Coast and Geodetic Survey, by the highly trained British Survey of India, and by various observers on the Continent of Europe.

"Briefly," said Prof. Lamb, "the general result is this, that in mountainous regions the observed value of gravity is abnormally low, whilst on oceanic islands, and so far as can be ascertained on the sea, it is abnormally large, when all allowance has been made for altitude and the normal variation with latitude. The fact that this has been found to be the case in so many different places, shows that we have here to deal with no casual phenomenon."

The explanation accepted by Prof. Lamb is briefly that there is denser matter under the oceans, to a depth of 60 miles, while under the mountains there is lighter matter to a depth of 60 miles. The denser matter causes a greater pull of gravity upon objects on the surface, and the lighter matter, less. Thus an object in Albany, N. Y., for example, will "weigh" less than an object of equal mass in Hawaii.

"If we imagine," said Prof. Lamb, "a level surface to be drawn at a depth of about 60 miles, the stratum of matter above this, though varying in density from point to point, is approximateley uniform, in the sense that equal areas of the surface in question bear equal weights. The altitude of the mountains is compensated by the inferior density of the underlying matter, whilst the oceanic hollows are made up for by increased density beneath.

"This suggests, as is highly plausible on other grounds, that the matter in the interior of the earth, below the stratum referred to, is in a state of purely hydrostatic stress, *i. e.*, of pressure uniform in all directions. So far as this stratum is concerned, it might be floating on an internal globe of liquid."

To What Uses Can You Put Old Celluloid Sheets?

SCIENCE AND INVENTION wants to know what kind of useful articles can be made out of old photographic films or other sheets of celluloid. In order to present the best uses for this material to our readers, we are offering $100.00 in prizes for suggestions for the best uses of old films. Dig out some of your old camera films that did not turn out as well as they might and see if you can make something out of them that will be useful, interesting and novel. Note the large number of worth-while prizes that we are offering and follow the contest rules carefully.

CONTEST CONDITIONS

1—The article must be made from old photographic films of any size or similar celluloid sheets.

$100.00 IN PRIZES

First Prize	$25.00
Second Prize	15.00
Third Prize	10.00
Four Prizes of $5.00 each	20.00
Six Prizes of $3.00 each	18.00
Six Prizes of $2.00 each	12.00
	$100.00

2—The number of entries per contestant is not limited.

3—In event of ties the full amount of the prize tied for will be awarded to each tying contestant.

4—Films may be cemented, cut, steamed or pressed to form objects.

5—No prizes will be awarded for articles described previously.

6—A rough sketch and a description of fifty words or less per object are required. Models are not required but may be entered. (CAUTION: Do not send inflammable celluloid articles through the mails).

7—Contest closes in New York on Wednesday, Dec. 30th at noon. All contributions must be in our hands at that time. Address entries to Editor, Old Film Contest, c/o SCIENCE & INVENTION, 53 Park Place, New York City.

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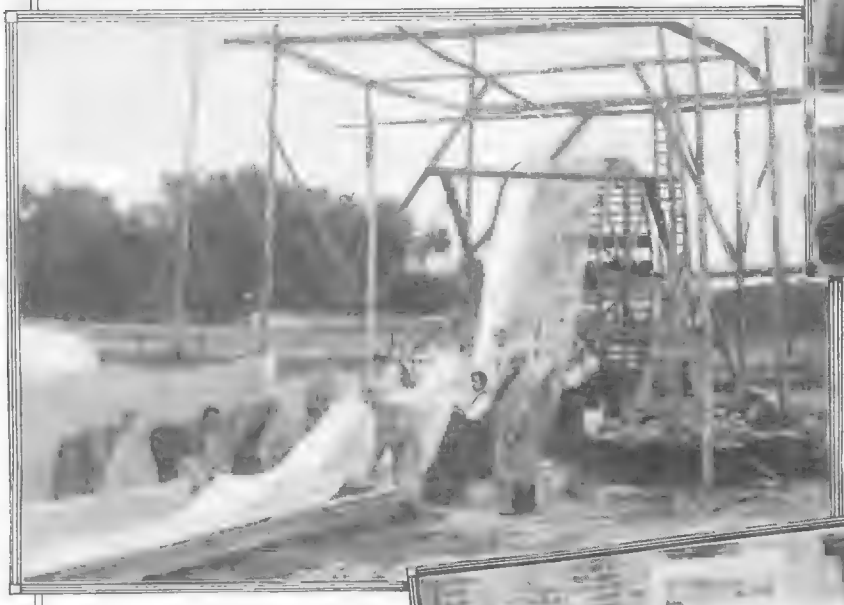
How Huge Photographs Are Made

Panoramas 39 Feet Long Are Developed at Night in the Open Air

The long panoramic photographs recently prepared by a German concern bring to mind the enormous camera designed by a Chicago engineer and illustrated at the left. With a bellows extension of 21 feet, the camera took pictures on a glass plate having an area of 42 square feet. The complete apparatus weighed 1,564 pounds and had to be transported on a freight car.

A photograph of the Gulf of Naples was recently prepared 39 feet long by 4 feet 9½ inches wide in dimension. It was made in six sections and the original plates from which the enlargements were made measured only 8 x 10½ inches. After the enlargements were made on a long roll of sensitized paper, a specially designed drum and series of washing and fixing troughs had to be employed. These were placed out in the open air and all of the work on the light sensitive film up to the final washing and drying had to be done at night.



The illustration above shows the enormous panorama on the drum 41 feet in circumference. Here it was developed, washed and then submitted to a fixing bath. The entire surface of the paper was immersed in the various solutions, a portion at a time. The drum was kept in constant rotation so as to insure as nearly perfect development as possible. Then the under exposed parts were treated with strong developer and the over-exposed parts with acetic acid.

After the developed panorama had been immersed for 20 minutes in a bath of acetic acid, it was washed and fixed for three-quarters of an hour. Then it was washed in running water for 8 hours and dried for 10 hours. The finished reproduction was then retouched by skillful artists, working as shown at the right. Thus the small imperfections were covered up.

Photos Courtesy Die Umschau.

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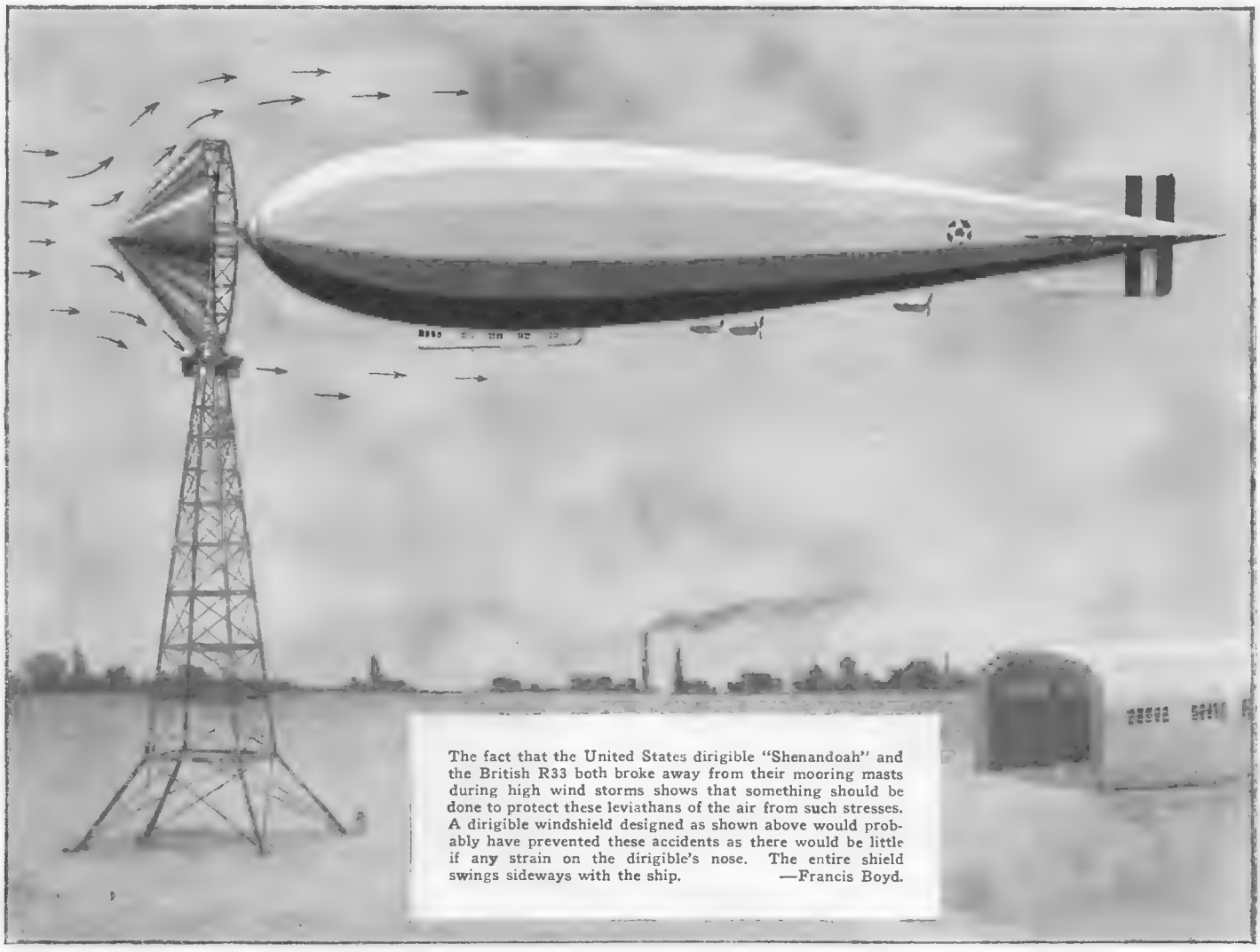
Shielded Mooring Mast



The fact that the United States dirigible "Shenandoah" and the British R33 both broke away from their mooring masts during high wind storms shows that something should be done to protect these leviathans of the air from such stresses. A dirigible windshield designed as shown above would probably have prevented these accidents as there would be little if any strain on the dirigible's nose. The entire shield swings sideways with the ship. —Francis Boyd.

Balloon Jumping Sport

FROM London we have received word of the very latest fad in the line of sports. All that you have to do to indulge in this exhilarating pastime is to provide yourself with a small balloon that is not quite buoyant enough to lift you completely off of the ground. This is to be strapped to your body by means of a suitable harness and you are ready to go out and jump over a house, across a wide stream and even over fences and trees. A slight push of your feet against the earth will send you many feet into the air. You will float back toward the ground and if your balloon is filled properly, you will land as light as a breeze-blown thistle. By properly directing the pressure against the ground and possibly by manipulating the body while in the air it should not take long for anyone to soon place himself in control of his balloon, so that he can land at almost any desired spot within reason. Races with balloons of this sort would undoubtedly be great fun and the danger would be very slight. Obstacle races of course would be the most fun because you then bring the advantages of the balloons into full play. We hope to soon see this sport developed by some American balloon manufacturer in this country.

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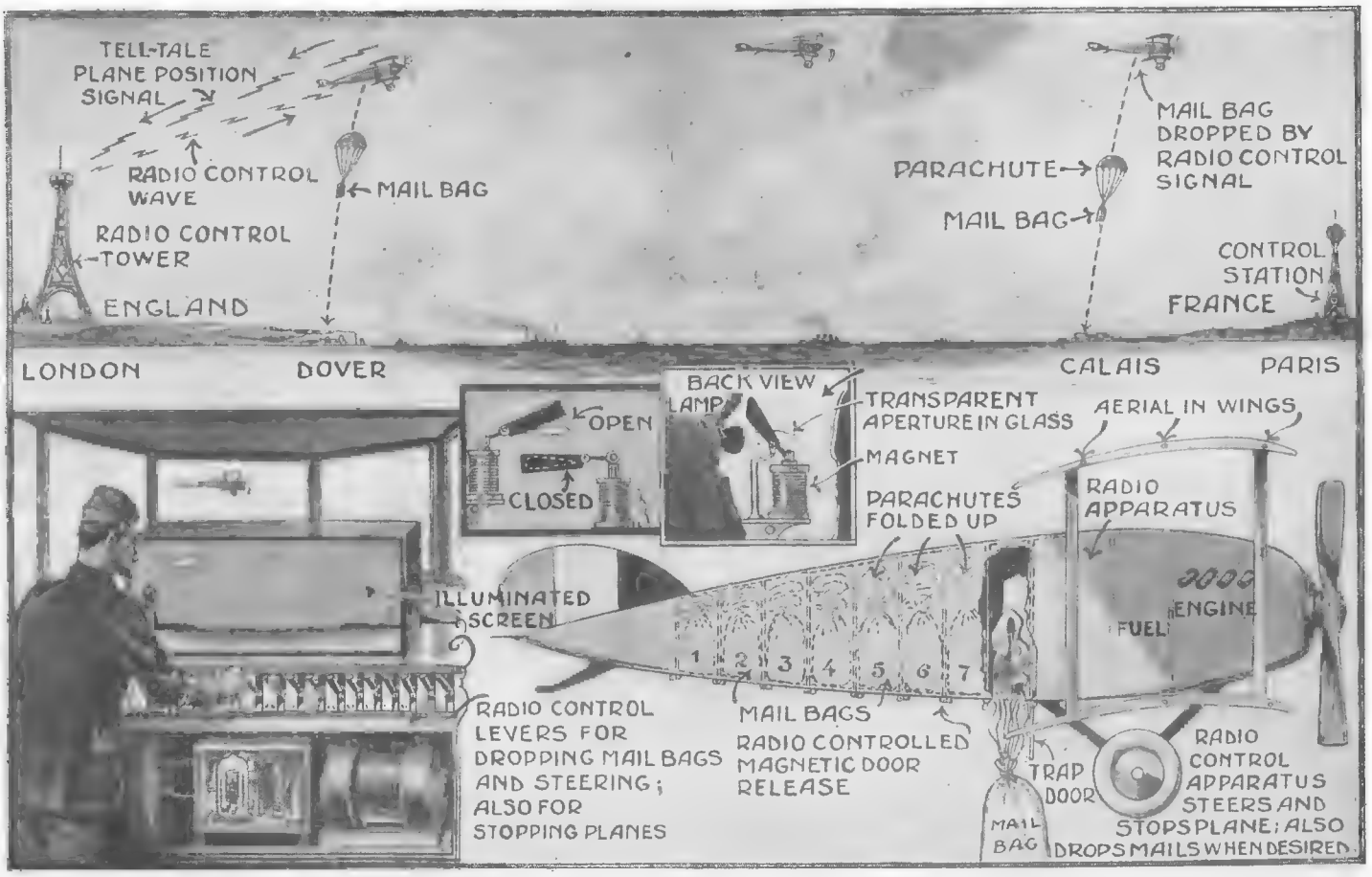
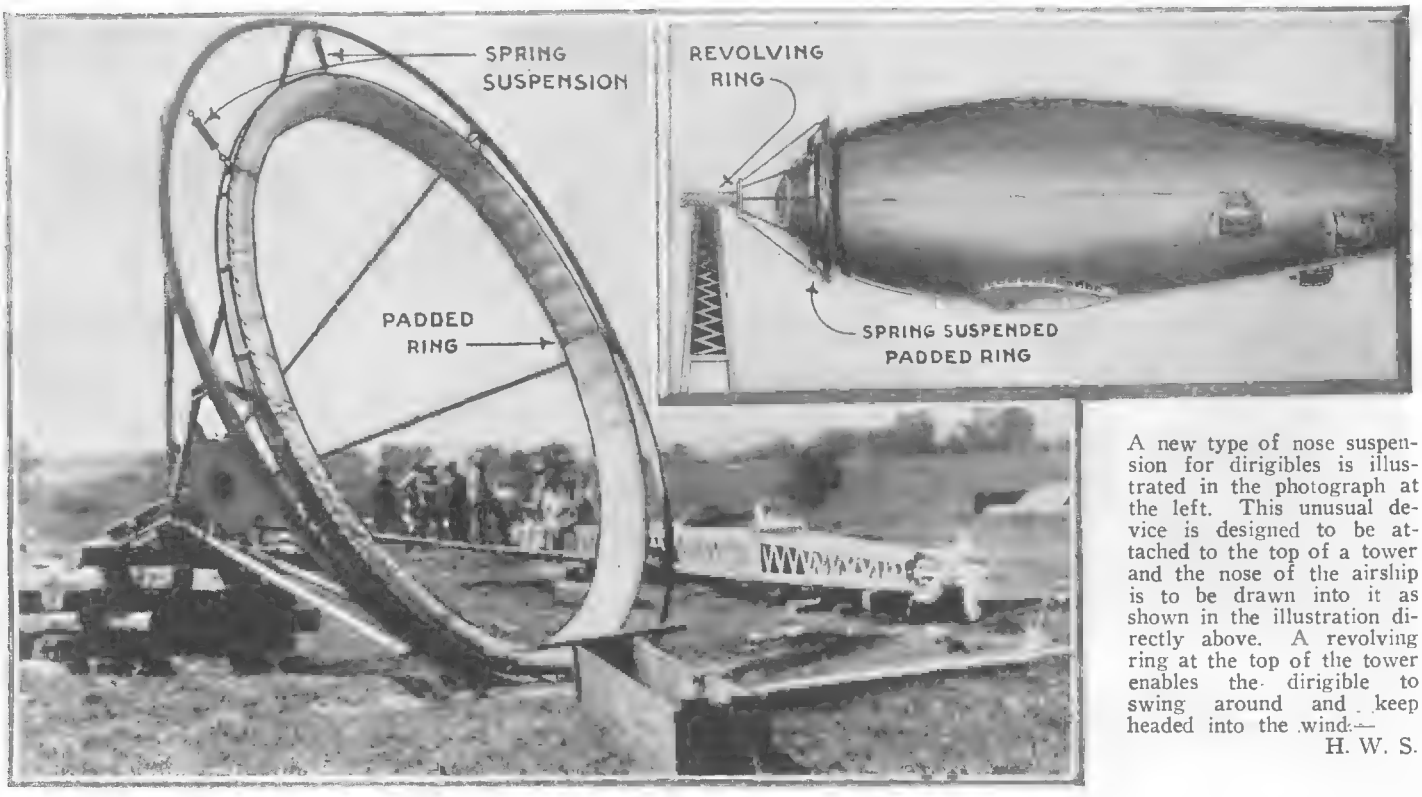
Radio Controlled Air Mail Planes



Of French design is the radio controlled air mail plane illustrated in detail and in operation above. A continuous series of signals sent out from the plane will illuminate apertures in a ground glass screen placed in front of an observer at one of the terminals thus showing the exact location of the plane at any time. The details of this mechanism are given in the center illustration. The mail is dropped by parachutes. —H. T. Wilkins.

Padded Ring Holds Dirigible



A new type of nose suspension for dirigibles is illustrated in the photograph at the left. This unusual device is designed to be attached to the top of a tower and the nose of the airship is to be drawn into it as shown in the illustration directly above. A revolving ring at the top of the tower enables the dirigible to swing around and keep headed into the wind.—

H. W. S.

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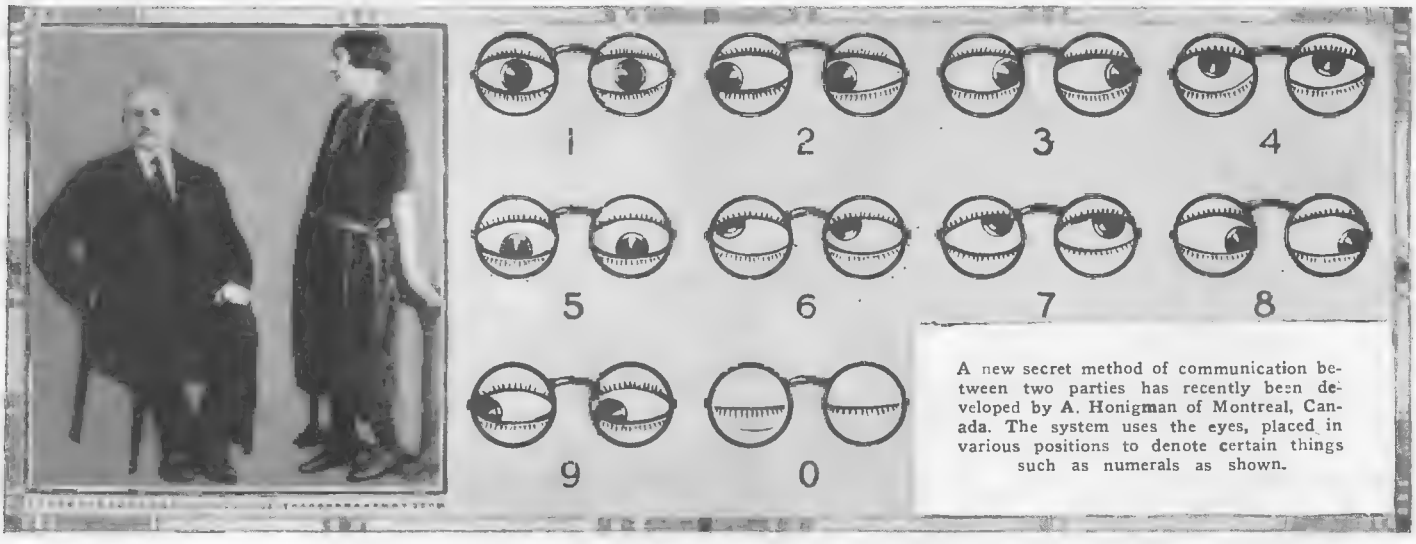
Freak Lightning Bolt Dodges Transformer

By HORACE THOMPSON

Two most unusual things are illustrated directly above. The first feature is a most extraordinary one, but not only because it depicts two separate and distinct flashes of forked lightning. This fact alone is enough to make the picture worthy of consideration. The second unusual feature is that it shows the lightning bolt on the extreme right dodging a power transformer on a 60,000 volt transmission line. Although the currents set up in the lines by the lightning threw automatic switches, still no damage was done either to the wires or to the equipment on the lines.

Eyes That Talk



A new secret method of communication between two parties has recently been developed by A. Honigman of Montreal, Canada. The system uses the eyes, placed in various positions to denote certain things such as numerals as shown.

The inventor of this system, shown above with his daughter, claims that he can transmit messages to her almost as fast as even a rapid speaker can talk. The method entails the learning of a code that can be changed to suit individual purposes. It is said that many police forces are interested in it, and that it is also adaptable to mind-reading artists on the stage. In this system, the facial muscles are not used at all. Only almost imperceptible movements of the eyes transmit intelligence. It is claimed that with a little practice, anyone can become an expert with this code and can make up his own system of communication that will be strictly private. It should prove a boon to detectives.

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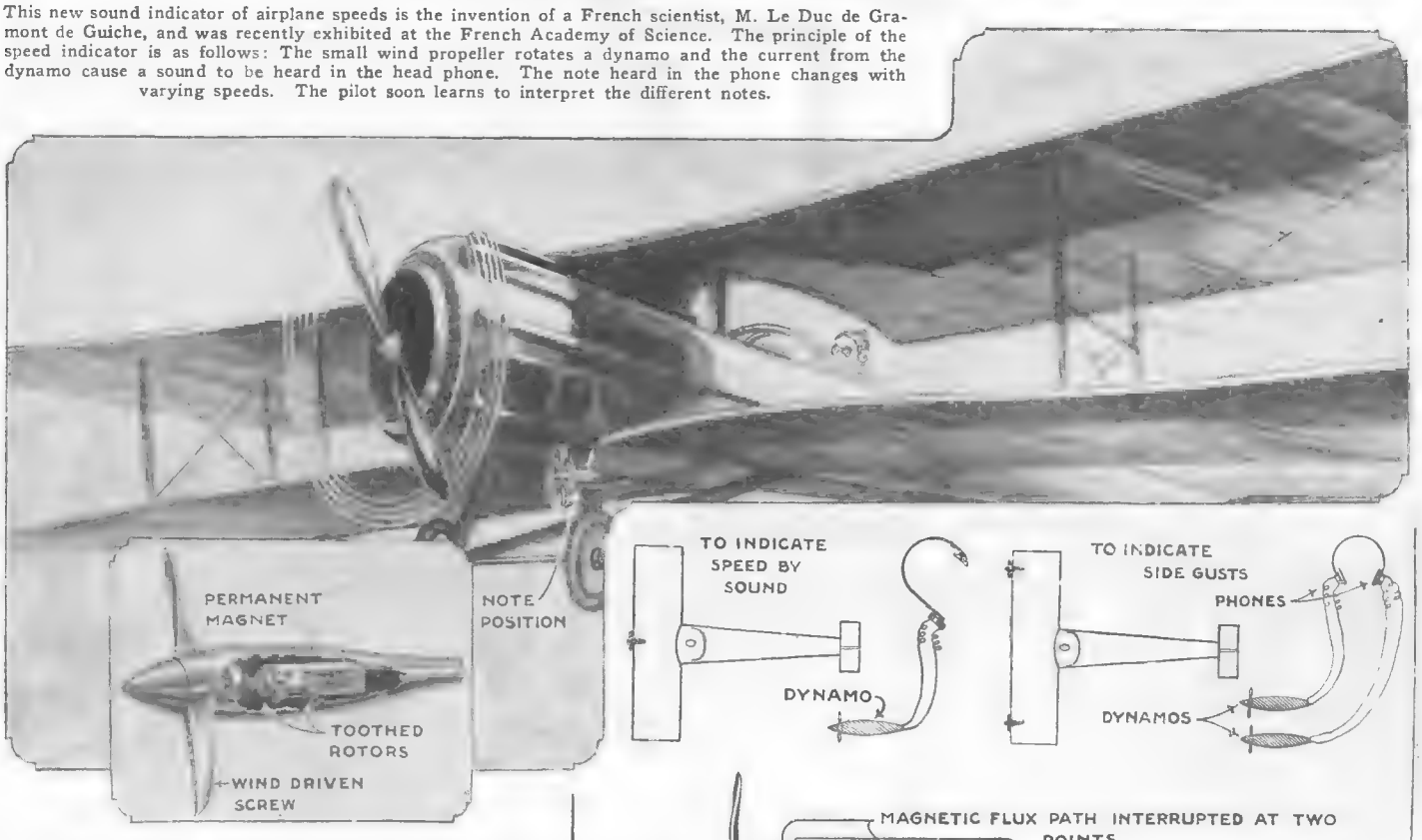
Sound Indicates Airplane Speed

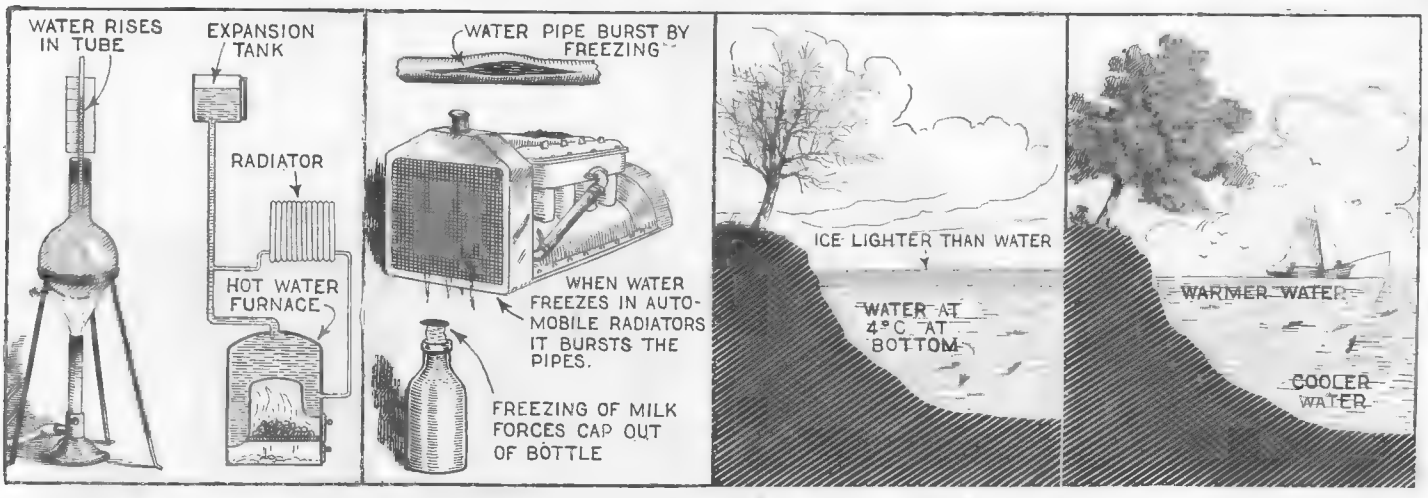
This new sound indicator of airplane speeds is the invention of a French scientist, M. Le Duc de Gramont de Guiche, and was recently exhibited at the French Academy of Science. The principle of the speed indicator is as follows: The small wind propeller rotates a dynamo and the current from the dynamo cause a sound to be heard in the head phone. The note heard in the phone changes with varying speeds. The pilot soon learns to interpret the different notes.



The three illustrations herewith show the new airplane speed indicator in detail as well as in actual use. A small alternating current dynamo is mounted in a suitable position on the wings or struts, and the faster the plane goes, the greater the speed of the wind driven dynamo. The potential of the alternating current delivered by the dynamo varies in practically direct proportion to the speed at which it is driven by the propeller. Any variations in airplane speed therefore, changes the pitch of the sound heard in the telephone receivers worn on the pilot's head. The dynamo comprises a permanent steel magnet field, while the magnetic flux from this magnet in its path through the induction coil, is interrupted by the rotating toothed wheels mounted on the propeller shaft. The faster the propeller shaft turns, the greater the number of interruptions per second, and the higher the note heard in the phones.

Lieutenant Thoret, French pilot, tried this speed indicator and found it very satisfactory. One of the diagrams above shows two of these speed indicators arranged on either wing to indicate the presence of side wind gusts, which indication will be given before the movement of the plane disclosed it by rocking.

Peculiar Properties of Water


WATER RISES IN TUBE
EXPANSION TANK
RADIATOR
HOT WATER FURNACE
WATER PIPE BURST BY FREEZING
WHEN WATER FREEZES IN AUTOMOBILE RADIATORS IT BURSTS THE PIPES.
FREEZING OF MILK FORCES CAP OUT OF BOTTLE
ICE LIGHTER THAN WATER
WATER AT 4°C AT BOTTOM
WARMER WATER
COOLER WATER

When heated, water expands and in the experiment at the left above, water in a flask when heated, rises in tube. This is the reason for the expansion tank used in connection with so-called hot water furnaces.

On the other hand, water will also expand when subjected to a temperature of less than 4° Centigrade. Freezing water will burst a pipe or the radiator of an automobile. Water in milk freezes with effect shown.

The maximum density of water is at 4° Centigrade. Below that point it expands and eventually forms ice. Therefore, ice rises to the surface and only under intense cold will a body of water freeze to the bottom.

The properties of water mentioned are the saviors of maritime life. Fish can live under the ice and during hot weather they can retreat to the cooler water inasmuch as the warm water rises to the surface.

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Advertising by Odor

Although the average person does not realize it, many of the human emotions are dependent to a greater or lesser extent upon the stimulation of the organs of smell. Odors have the power to stimulate various functions of the body and particularly is this true in connection with the senses that are employed during the process of assimilating food. One of our correspondents has put forth in a humorous way an advertising suggestion that is actually more serious than it appears at first glance. Our illustrations show his idea.

We all know the desires that are aroused within us upon smelling some particularly enticing odor. Undoubtedly open air stands of the type shown above that cater to the gastronomical desires of the public would be more attractive if fitted with "odor directors" of the type illustrated.

Restaurants could also utilize the effect of odors upon its patrons by projecting the smell from the particular specialty of the day into the dining room by means of an electric fan or blower located as shown in the above illustration.

—A Kaufman.

As a Worm Sees Golf

In order to study the position assumed and the method by which a correct drive in golf should be made, the unique arrangement illustrated at the right was pressed into service. A piece of ¾-inch plate glass was mounted on a framework and the movie camera, situated directly below it, was focused up through the glass. A golf player took his position on top and drove off from the glass. The resulting pictures were most unusual and one of them is reproduced directly above.

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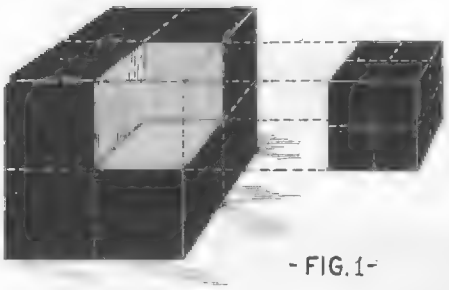
Can We See Atoms?

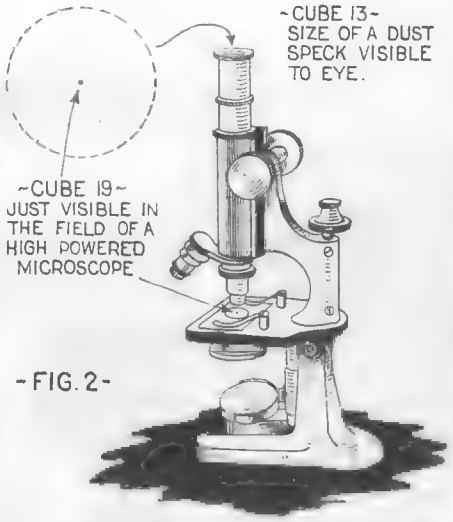
By DR. JOSEPH M. HOWARD



- FIG. 1 -

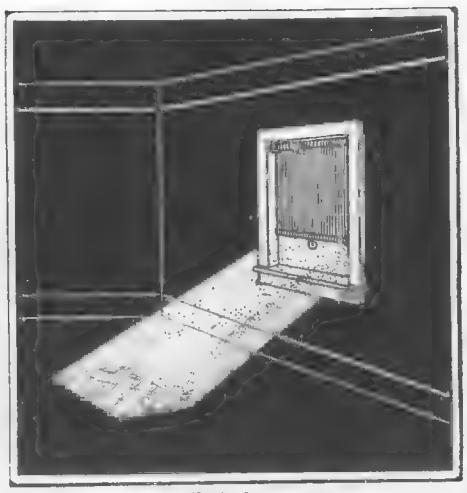
The early Roman philosophers often argued the question of the structure of matter. One school insisted that a cube of any substance could be subdivided indefinitely, while the other school theorized that if the process of cutting were carried out, we would finally arrive at a particle which could not be made smaller. They called this an "atom" which signifies "indivisible." Modern chemistry and physics have upheld the latter school until recently and now we hold that all matter is built up of atoms, and the atom of a nucleus and electrons.

Fig. 1 represents a cube of iron a foot on each side. Imagine the cube cut along each of the dotted lines, forming eight smaller cubes. Continue the cutting operation on one of the small cubes.



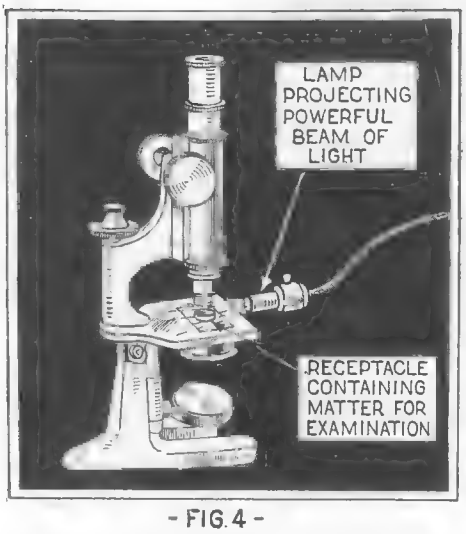
- FIG. 2 -

Cube No. 13 will be only 1/1000th of an inch across and so small that it will be practically invisible to the eye. Yet this cube has 1,000,000,000,000,000 atoms within it. Cube No. 19 is 1/60th as large and cannot be seen without a microscope.



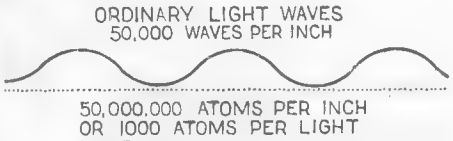
- FIG. 3 -

Fig. 3 above shows how dust particles may be made visible by passing a beam of light through the air in which they are suspended. This principle is applied to the ultra-microscope illustrated in Fig. 4. Without using this principle, the smallest particle visible to a high powered microscope contains millions of atoms.

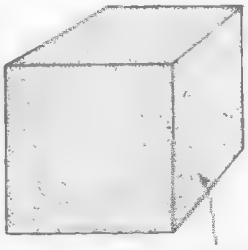


- FIG. 4 -

With the ultra-microscope illustrated above, cube No. 26 would be the last one that could be seen. It contains about 64 atoms and it is evident that we can never see an atom.



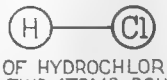
50,000,000 ATOMS PER INCH OR 1000 ATOMS PER LIGHT WAVE.



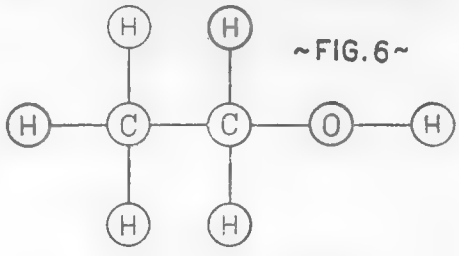
- FIG. 5 -

CUBE Nº. 19 CONTAINS -10,000,000,000,000 ATOMS

For any object to be visible it must reflect light. It is obvious that the atoms are far too small to reflect light. Cube No. 19 is slightly larger than a wave of light and can be seen directly. The smaller cubes are not actually visible in the light, but scatter the light to one side and produce bright streaks visible in the ultra-microscope.



MOLECULE OF HYDROCHLORIC ACID---- CONTAINING TWO ATOMS BOUND TOGETHER.



~FIG. 6~

MOLECULE OF ALCOHOL--- CONTAINING NINE ATOMS BOUND TOGETHER

Molecules are combinations of atoms bound together as a single unit. Any number is possible but the more complicated ones are likely to be rather difficult to prepare. The upper part of Fig. 6 shows a molecule of hydrochloric acid which consists of one atom of hydrogen and one of chlorine. This is a very simple combination and on the other hand, "wine" alcohol is more complicated, as it consists of nine atoms bound together.

Revolving Truck Loader

European inventors often show us valuable tricks. Here is one that enables a driver to quickly and easily load the heaviest barrel onto a truck. It is built lightly but strongly and costs but little.

This new truck loader consists of a metal platform supported by iron beams which is free to revolve around a fixed horizontal shaft attached to the solid framework at the back of the truck. The device, invented by M. Biblis of Bayonne, France, operates as follows: To load a barrel on the truck, the metal platform is swung over and lowered to the ground, the barrel is rolled forward on the ground until it rests on the metal extension as in the left photograph above. The truck is then slowly and carefully moved forward and the loading platform revolves as it cannot slip along the ground, raising the barrel as in the center photograph. When the platform comes to a level with the truck body, the barrel is pushed forward upon the truck.

—H. T. Wilkins.

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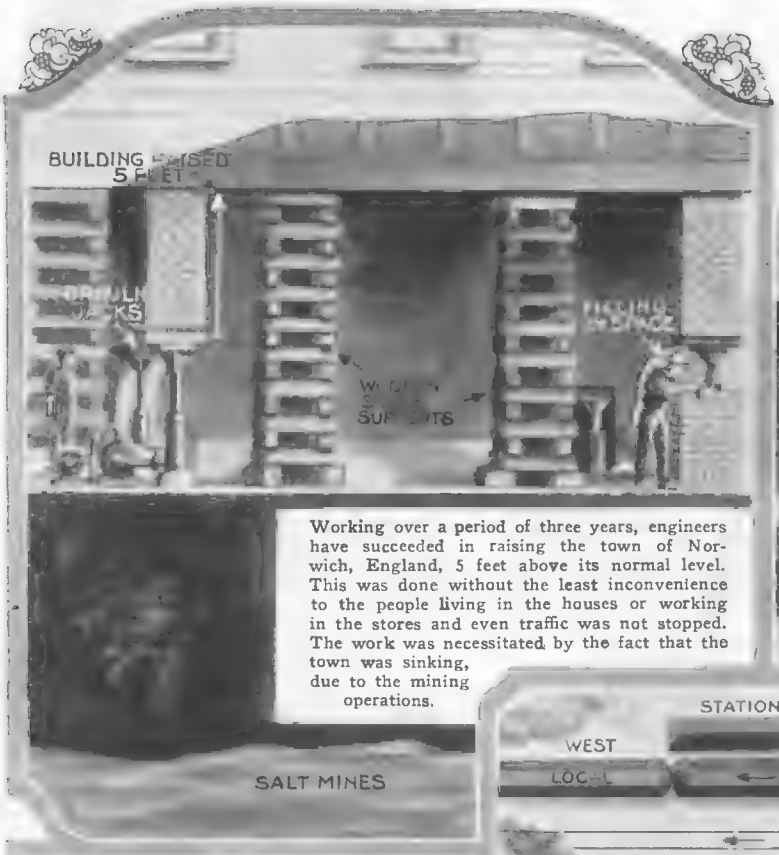
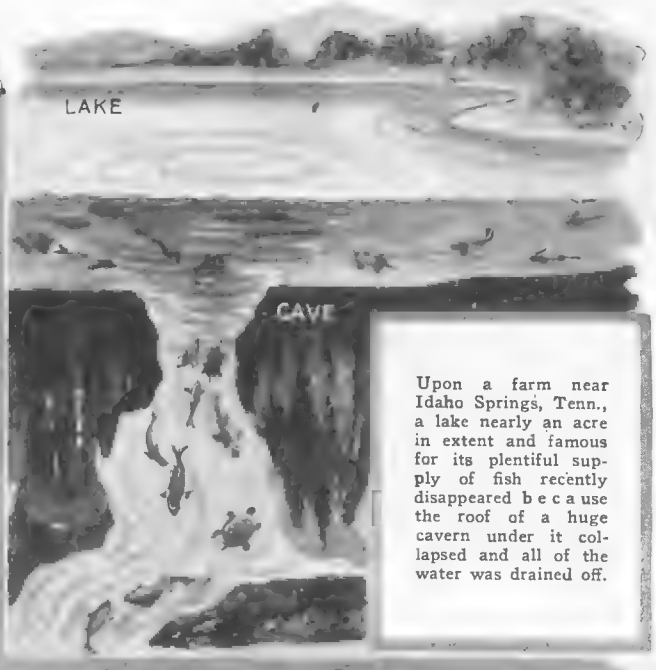
The Month's Science News Illustrated

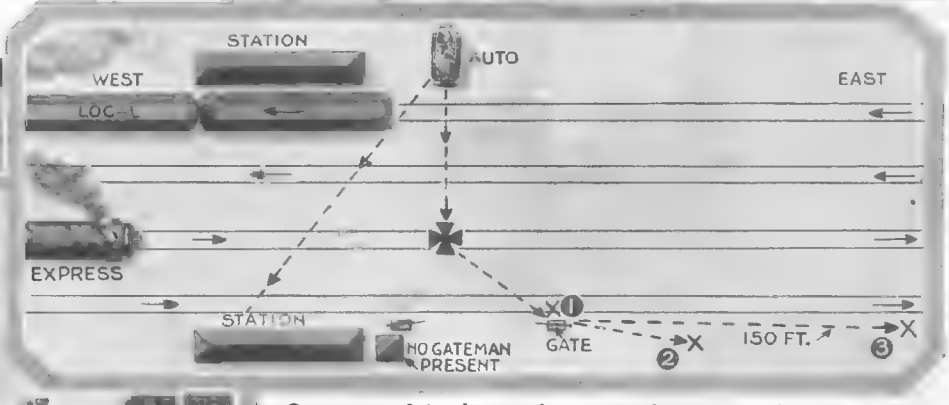
Illustrated by George Wall



Working over a period of three years, engineers have succeeded in raising the town of Norwich, England, 5 feet above its normal level. This was done without the least inconvenience to the people living in the houses or working in the stores and even traffic was not stopped. The work was necessitated by the fact that the town was sinking, due to the mining operations.

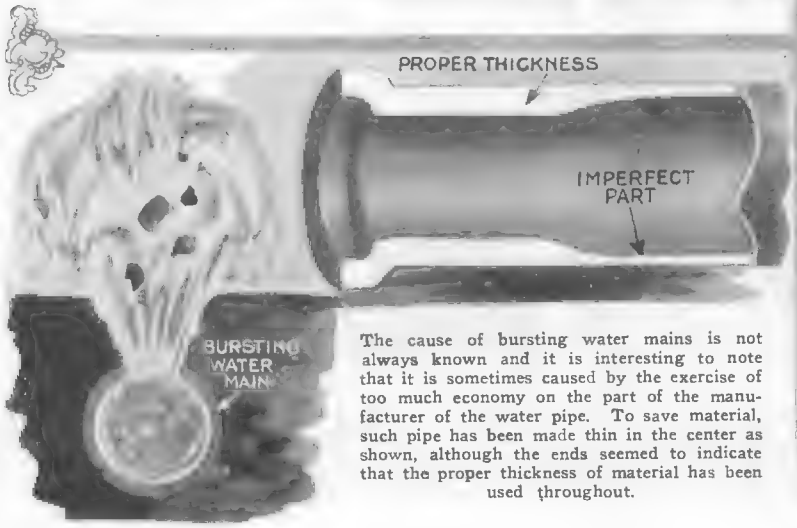


Upon a farm near Idaho Springs, Tenn., a lake nearly an acre in extent and famous for its plentiful supply of fish recently disappeared because the roof of a huge cavern under it collapsed and all of the water was drained off.



On account of the absence of a gateman from a railroad crossing two men were instantly killed and a third was seriously injured. A local train, in the position shown, concealed an eastbound express from the automobile driver. The car was thrown to 1, the injured man to 2, and the two dead bodies were found at 3.

A short-circuit between wires carrying electricity recently caused a devastating fire in Arrouxville, France. Two small birds were the cause of this fire, which damaged 15 houses.



The cause of bursting water mains is not always known and it is interesting to note that it is sometimes caused by the exercise of too much economy on the part of the manufacturer of the water pipe. To save material, such pipe has been made thin in the center as shown, although the ends seemed to indicate that the proper thickness of material has been used throughout.

In Berlin, Germany, the "public bob" has been introduced. Seated on a raised dais in the center of a public garden, the "victim" is shorn of her locks with much pomp and ceremony. The fad has become very popular and public hair-cuts are said to be in great demand.

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MAGIC By "DUNNINGER"

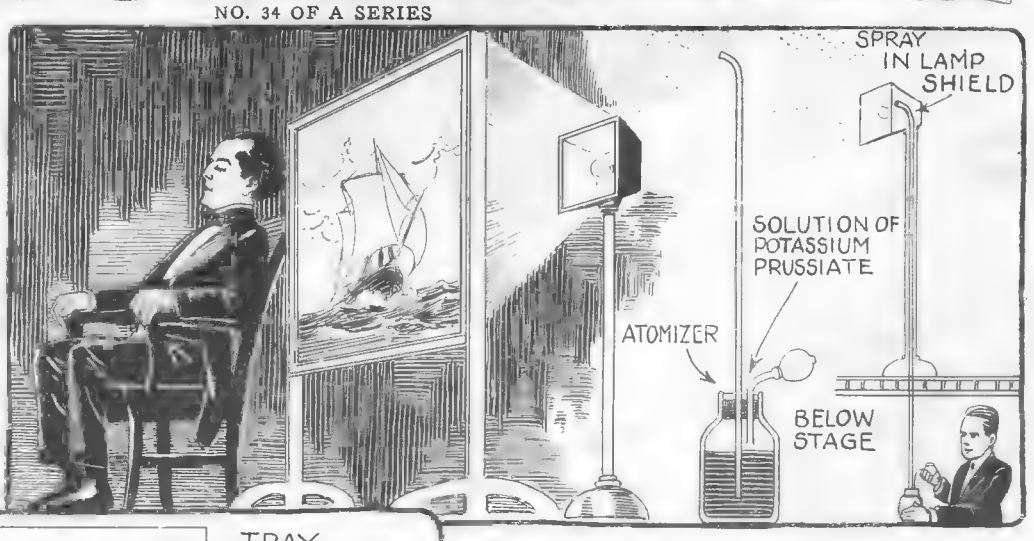
THE MAN WHO MYSTIFIED

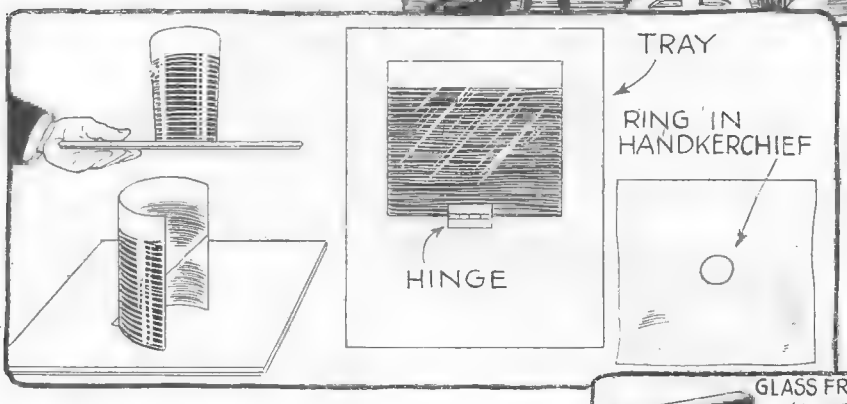
Prince of Wales, Ex-President Harding, Taft, Roosevelt, Pres. Coolidge and other celebrities Writes Exclusively for SCIENCE AND INVENTION

Folks Are Mystified Yet Delighted by This Man!
DUNNINGER REACTIONS COMMITTEE IN LIBRARY TEST OF MIND READING
Mind You! The Mind Reader Really Read the Mayor's Mind
DUNNINGER DRAWS MORE BIG CROWDS
Dunninger Will Attempt To Hypnotize Patient, 10 Miles Away, by Radio

NO. 34 OF A SERIES

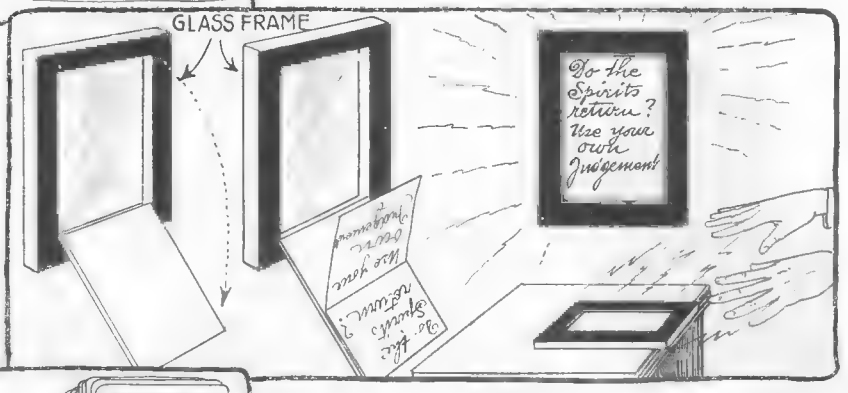
Spirit Pictures: The magician playing the rule of a medium sits before a large canvas covered frame placed on an easel. A lamp with a powerful light is fixed directly behind the canvas, rendering it transparent. As the medium goes into a trance and the lights are lowered, a picture in colors gradually forms. This effect is produced by an assistant below the stage, who holds in his hand a bottle containing a solution of potassium prussiate. A tube leading from the bottle runs through the light stand through which the solution is sprayed upon the canvas. The canvas itself has been previously painted with solutions of iron sulphate, bismuth nitrate and copper sulphate for blue, yellow and brown colors respectively. When these solutions dry they are invisible. It is preferable to lightly outline the picture to be painted with a pencil before applying the solutions.

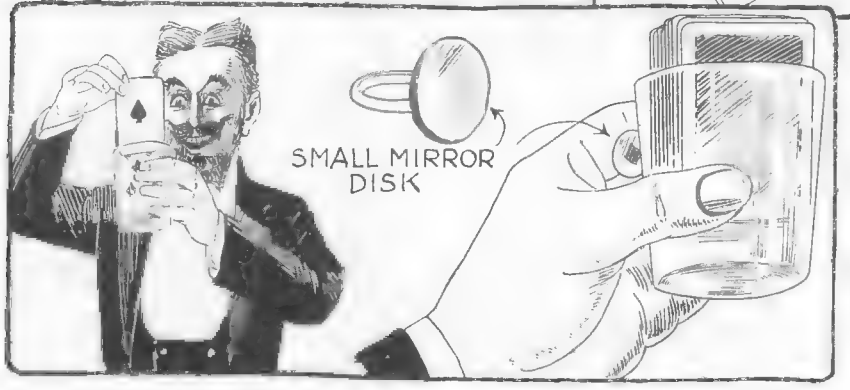




Magic Tumbler: The effect of this mysterious trick is attained by very simple apparatus. The magician's assistant comes forth with a thin metal tray holding a large tumbler of wine. The conjurer covers the glass with a silk handkerchief and removes it from the tray. Tossing the kerchief into the air the glass and its liquid contents have apparently vanished. The telltale diagrams accompanying disclose the secret. The glass itself is nothing more than a sheet of celluloid held in position as here illustrated in a semi-circular form by means of a thread. The celluloid is painted to resemble wine. When the thread is released the piece of celluloid falls flat upon the tray and is invisible. A metal ring placed in a pocket in a handkerchief of the same size as the supposed glass enhances the illusion.

The Ghost Frame: This particular offering has been used by the author for a number of years and holds the distinction of having mystified some of the cleverest and best posted magicians in the country. It consists of a large wooden frame in which is fixed a sheet of glass. A flap which opens up as illustrated is hinged to the affair. The flap being shown empty and the glass frame being exhibited, the affair is closed and placed face down upon the table, but in the act of closing, the "flap within a flap" is permitted to fall, exposing the secret contents. With a little practice the magician can manipulate the apparatus with such dexterity that the action of causing the second flap to fall is unobserved by the spectators.





Twentieth Century Mind Reading: In this particular experiment an unprepared deck of cards bearing the closest of inspection is freely shuffled and placed into a glass tumbler, which is held at arm's length by the magician. In spite of the fact that the cards face the audience with their back to the performer, he mysteriously calls the exact rotation of the entire deck reading the cards in front first, and removing one at a time as he reads them. The magician does not have to have his own deck for this experiment as any deck will serve the purpose. Like most good effects the trick is extremely simple, the magician having merely provided himself with a small mirror disk, attached to a flesh colored band or a ring. The small dental mirrors serve the purpose admirably. One need merely look at the index of the card and name it.

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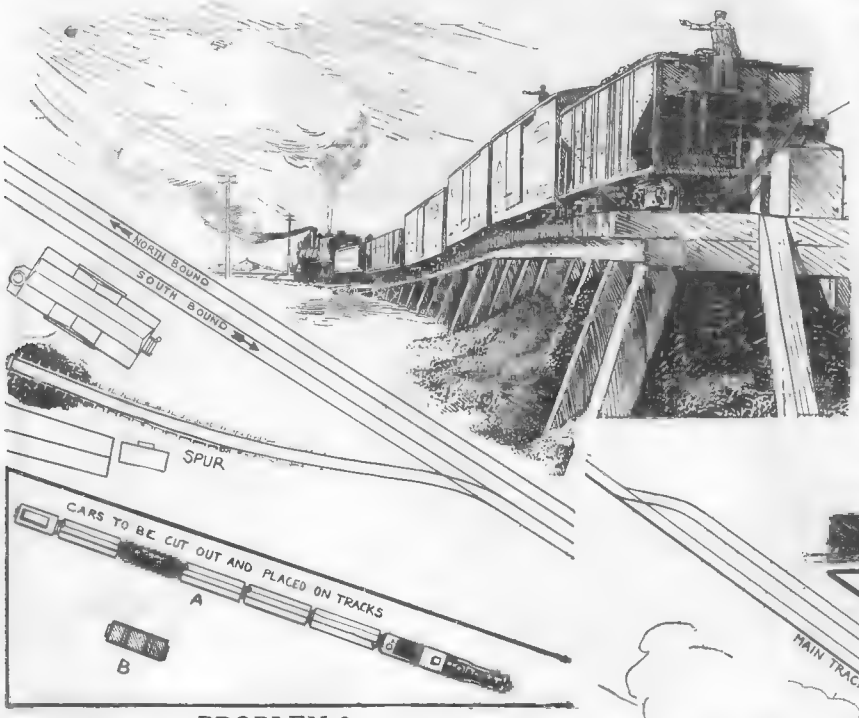
Railroad Switching Problems

Here Is An Entirely New Type of Brain Teaser that Will Test Your Reasoning Powers to the Utmost. These Puzzles are Based on Standard Railroad Practice, the Author Being a Railroad Man of Long Experience.

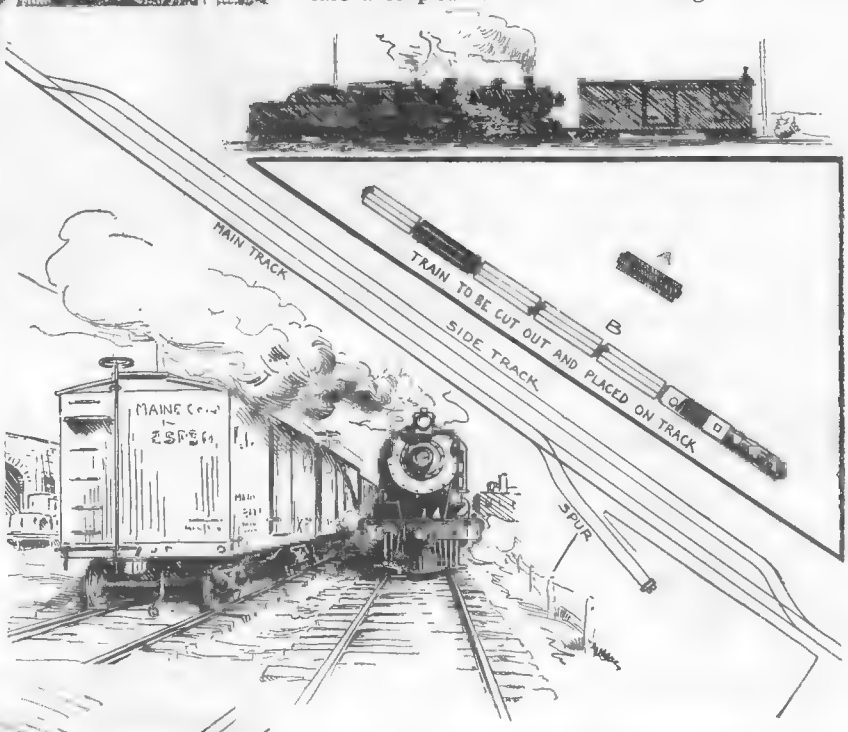
By B. M. FAIRBANKS



If you would spend a few hours in the solving of some most interesting and absorbing problems, sit right down now and start in on those presented on this page. You can either puzzle out the problems in your head, perhaps with the aid of a pencil, or if you find this too arduous a task, cut out the little trains and cars shown in the triangles, place them on the tracks according to the directions and move them to solve the problem.

PROBLEM 1

Place train A on southbound track to the left of switch, facing as arrow indicates. Place empty car, B, on left end of spur over coal pile. The empty car is to be taken away and the loaded one in the train, indicated by black, left on the spur in the fewest possible moves. Trains to be moved and individual cars uncoupled as in actual railroading.

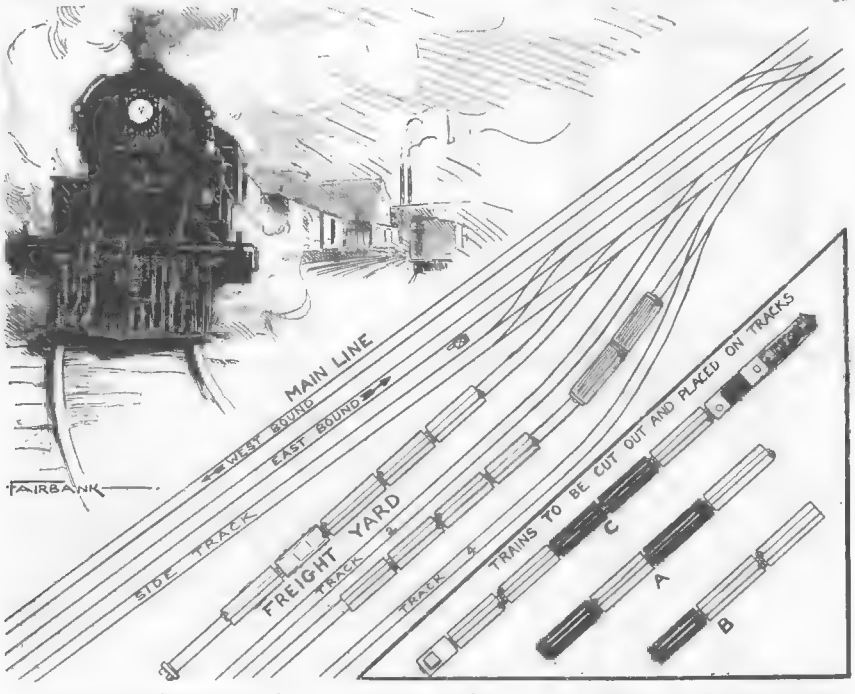


PROBLEM 2

Place train B, right, on main track, facing right, to left of spur. Empty box car, A, to be on spur and to be taken away. Loaded car, indicated by black to be left on spur and the train to proceed on its way after having made the fewest possible moves.

PROBLEM 3

As below, place train C, on eastbound track facing right with engine to left of switch. Place cars A on track 2 and cars B on track 4. The black cars on A and B should be to the left and are all marked for one destination, together with the black ones on C. Those in A & B must be taken on so that black cars will all come together on train, leaving the others in the yard. Other cars on train C will remain on that train.



Do not refer to the answers given at the right until you have exhausted your ingenuity without reaching a satisfactory solution.

Answer 1.—Uncouple engine from train, move forward until clear of switch, back on to spur, couple on empty car. Move forward to main line, back up, and couple on to train leaving two rear cars on main track. Move forward again until clear of switch, back on to spur, leave loaded car at end, move back to main track, back up, connect and proceed on your way.

Answer 2.—Break train at rear of third car and proceed ahead to switch. Back on to side track and around to main track again. Uncouple engine from train and move to rear of cars ahead, push cars on to spur. Couple on empty cars, on to main track again. Push empty car beyond spur, and uncouple empty car and back up. Push loaded car on spur, uncouple and back to main track, go forward on main track and couple car to empty car, uncouple engine, back up to train, couple on car and proceed on to side track and around to main track, back up to cars, couple on, and proceed.

Answer 3.—Uncouple engine from train, go forward, then take switch, back to side track, then forward and back to track 2. Bring out the four cars, and back four along side track, leave one black car, go forward again, till clear of track 2. Back on to track 2, leaving one car and go forward to side track. Back up and leave second black car on side track, go forward to farthest switch, back on to track 4. Couple on remaining cars, and go to side track, back up on side track and leave remaining black car. Go forward, then back to track 2 leaving the remaining three cars. Uncouple cars, forward to side track, back up beyond switch, go forward, take switch to main track, back up, couple on first car only, go forward, back on to side track, couple on the three remaining cars, go forward to main track, back up to train, then proceed.

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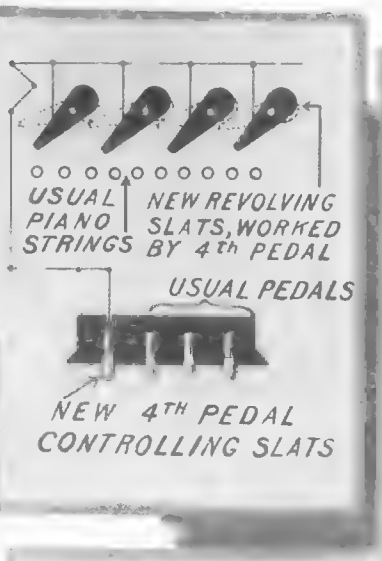
The Latest Inventions

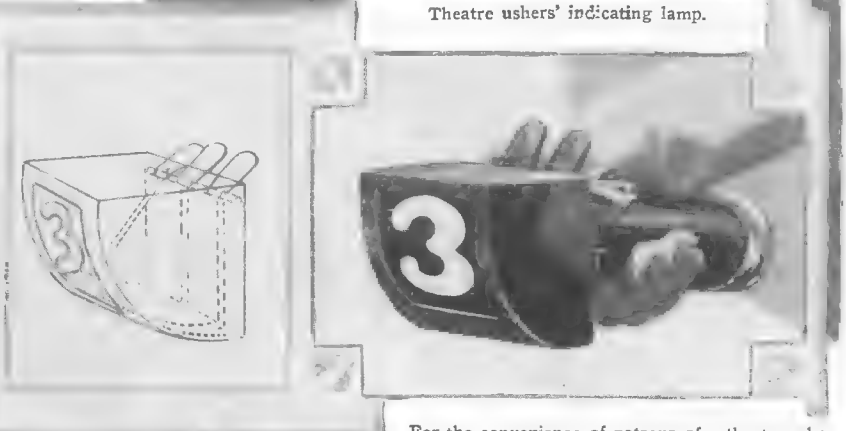
The Various Devices Described Show the Diversified Field of Invention and How the Inventor Can Turn His Ingenuity Successfully In Different Directions

A new principle developed by John Hays Hammond, Jr., when applied to a pianoforte enables the musician to produce the sonorousness and sustained notes of a pipe organ, yet all of the characteristics of the pianoforte are retained. The effect is had by opening or closing a series of slats operated by a fourth pedal. When closed, a reverberating sound chamber is produced and by opening and closing the slats, a remarkable control of volume may be had. The effect is said to be most surprising.

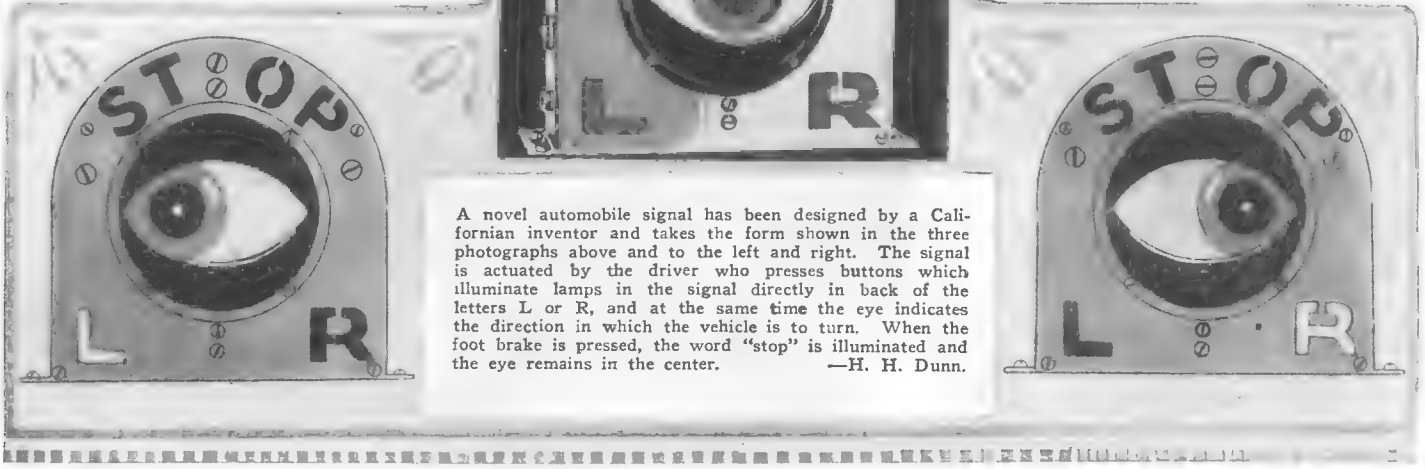


Theatre ushers' indicating lamp.

An Eastern concern has placed on the market a product that promises to rival ordinary desk paper stapleing machines because of the ease with which it can be used, and on account of the feature of an automatic staple ejector, so that the machine cannot under any circumstances become clogged. It is loaded with wire staples, and works in the same manner as a pair of pliers. The machine is shown in use above being employed to fasten a sheaf of paper together. —K. B. Murray.



For the convenience of patrons of a theatre who are waiting at the head of the aisle while the usher finds seats for them, the device illustrated in the photographs and drawing above has been invented. It consists of a small metal box designed to be clamped to the end of a flashlight, within which numbers are so arranged that by pressing a lever and turning on the flashlight, a number can be seen through a window in the front of the box, being stamped out of sheet metal so that the light can shine through. The number indicates the number of vacant seats. —K. B. Murray.



A novel automobile signal has been designed by a Californian inventor and takes the form shown in the three photographs above and to the left and right. The signal is actuated by the driver who presses buttons which illuminate lamps in the signal directly in back of the letters L or R, and at the same time the eye indicates the direction in which the vehicle is to turn. When the foot brake is pressed, the word "stop" is illuminated and the eye remains in the center. —H. H. Dunn.

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Tarrano the Conqueror

SEVENTH INSTALLMENT

By RAY CUMMINGS

First American and Canadian Serial Rights

Then abruptly from below the northern horizon lights came up—spreading colored beams. The Earth war vessels!

SYNOPSIS

IN the spring of the year 2325, all of the rulers of the various countries of the earth are mysteriously murdered. Jac and Grayson, employees of a large news organization, find that the murders are the result of a plot on the part of the inhabitants of Venus. Tarrano, an erstwhile lower official of the Cold Country of Venus is found to be at the head of a plot to rule the universe.

Dr. Brende, a friend of Jac's has discovered a medical method whereby human beings may be kept from growing old. The Doctor is killed by a group of "Venus-Men" and Jac, Elza, the Doctor's daughter and Georg, the Doctor's son, are captured and taken to Venia, a city on the earth inhabited by people of Venus. Here they are imprisoned and Wolfgar, a Venus-man, friendly to the people of the earth, surrounds them by an electrical isolation barrage in an attempt to rescue them. The barrage is broken down and in the resulting confusion, Georg escapes to Washington in company with Princess Maida of Venus.

The next day, Tarrano offers to return the papers and models of the invention made by Georg's father, which he has confiscated and brands young Brende as an impostor. To offset this accusation, Georg is to tell his story to the earth as well as to Venus and Mars by radio and helio. He and Princess Maida go to the station but there they disappear.

Jac, Wolfgar and Elza, still captives, are removed from their prison and taken to the top of an enormous tower. Here, in the instrument room, where communication with the various planets is held, they view the disappearance of the Princess Maida and Georg by television. The abduction has been done by Tarrano's agents. On Mars, Tarrano's followers are attacking the ruling class and Tarrano offers Dr. Brende's secret to the public if they will surrender to his cohorts. They agree. Tarrano then announces to the earth people, that he will not give them the Brende secret and declares war upon them, challenging them to attempt to conquer him.

CHAPTER XV
THE ESCAPE

THAT Tarrano should thus defy the Earth, when by every law of rational circumstance the move seemed to spell only his own disaster, was characteristic of the man. He stood there in the instrument room at the peak of the skeleton tower in Venia and rasped out to the Earth Council his defiance. Silence followed—silence unbroken save by the hiss and click of the instruments as the message was sent.

And then Tarrano ordered thrown upon himself the lights and sending mirrors so that his own image might be available to all of the public and Earth officials who cared to look upon it. Within the circle of mirrors he stood drawn to his full height; his eyes flashing, heavy brows lowered, and a sardonic smile—almost a leer—pulling at his thin lips. The embodiment of defiance. Yet to those who knew him well—as I was beginning to know him—there was in his eyes a gleam of irony, as though even in this situation he saw humor. A game, with worlds and nations as his pawns—a game wherein, though he had apparently lost, with the confidence of his genius he knew that the hidden move he was about to make would extricate him.

"Enough," he rasped.

The mirrors went dark. He turned away; and still without appearance of haste he drew Wolfgar, Elza and me to the balcony. Together we stood gazing over the lights of the city below us.

A cloudless, starry sky. Empty of aircraft; but to the north just below the horizon, we knew that the line of war vessels was hovering. Even now doubtless, they had their orders to descend upon us. Tarrano seemed waiting, and I suppose we stood there half an hour. Occasionally he would sight an instrument toward the north; and by the orders he gave at intervals I knew that preparations for action on his part were under way.

Half an hour. Then abruptly from below the northern horizon lights came up—spreading colored beams. The Earth war vessels! A line of them as far as we could see from left to right, mounting up into the sky as they winged their way toward us—a line spreading out in a broad arc. And then, behind us, I saw others appear. We were surrounded; and the circle was closing in.

It was a magnificent, awe-inspiring sight, that vast ring of approaching colored lights. Red, green and purple—slowly moving eyes. Light-rockets sometimes mounting above them, to burst with a soundless glare of white light in the sky; and underneath, the spreading white search-beams, sweeping down to the dark forest that lay all about us.

Soon, in the white glare of the bombs, we could distinguish the actual shapes of the vessels. Still Tarrano did not move from his place by the balcony rail. He stood there with a hand contemplatively under his chin, as though absorbed by an interest in the scene purely impersonal. Was he going to give himself up? Stand there inactive while these armed forces of the most powerful world in the Solar System swept down upon him?

Abruptly he snapped his instrument back to his belt. He had not used it since the hostile lights had appeared. Previously, I knew, he had been watching those lights with the curved ray of the instrument when the lights themselves had been below the horizon.

He turned now to me. "They are here, Jac Hallen. Almost here. And I am at their mercy." His tone was ironic; then it hardened into grimness. He was addressing me, but I knew it was for Elza's benefit he spoke.

"I came here to Earth, Jac Hallen, well for certain things. I find them now accomplished. I belong here no longer." He laughed. "I would not force myself into a war prematurely. That would be very unwise. I think—we shall have to avoid this —engagement. I am—slightly outnumbered."

He called an order, quite calmly over his shoulder. I suppose, at that moment, the Earth war vessels were no more than five miles away. The whole sky was a kaleidoscope of darting lights. In answer to his order, from the peak of our tower a light bomb mounted—a vertical ray of green light. The bomb of surrender!

Tarrano chuckled. "That should halt them. Come! We must start."

He held a brief colloquy with a Venus-man who appeared beside him. The man nodded and hastened back into the instrument room. The green light of our bomb had died away. The lights in the sky began fading—the whole sky fading, turning to blackness! I became aware that Tarrano had thrown around our tower a temporary isolation barrage. For a few moments—while the current he had at his command could hold it—we could not be seen on the image finders of the advancing vessels.

Tarrano repeated: "That should hold them—I have surrendered! They should be triumphant. And outside our barrage, our men will bargain with them. Ten minutes! We should be able to hold them off that long at least. Come, Lady Elza. We must start now."

With a scant ceremony in sharp contrast to his courteous words to Elza, he hurled us off. Three of us—Elza, Wolfgar and myself, with one attendant who still car-

. . . And on its high-raised stern, beneath a canopy was a couch upon which Tarrano reclined, with us of his party at his feet.

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ried Elza's personal belongings. Hurried us into the vertical car which had brought us up into the tower. It descended now, down the iron skeleton shaft. Outside the girders I could see only the blackness of the barrage, with faint snapping sparks.

Silently we descended. It seemed very far down. And suddenly I realized that we were going lower than the ground level. The barrage sparks had vanished. The blackness now was a normal darkness; and in it I could see slipping upward the smooth black sides of the vertical shaft into which we were dropping. And the sulphuric smell of the barrage was gone. The air how smelt of earth—the heavy, close air of underground.

I do not know how far down we went. A thousand feet perhaps. The thing surprised me. Yet in those moments my mind encompassed it; and many of Tarrano's motives which I had not reasoned out before now seemed plain. He had come from Venus to the Earth, possibly several months ago. Had come directly here to Venia and set up his headquarters. His purpose on Earth—as he had just told me—did not lie with warfare. While he was here his forces had conquered the Great City of Venus, and just now, the Hill City of Mars. He controlled Venus and Mars—but he was still far from ready to attack the Earth.

He had come to the Earth in person for several important purposes. For one—he desired the Brende model and Dr. Brende's notes. He had them now; they were, in reality, at this present moment in the Great City of Venus. Also, with the Brende secret—to control it absolutely—he had to have Georg Brende. Well, as I was soon to realize, Georg was now his captive. And the Princess Maida? His purpose in holding her was two-fold. She had, now as always in the Venus Central State, a tremendous sentimental sway upon her people. Tarrano had abducted her, forcibly to remove her from the scene of action, so that during her unexplained absence his propaganda would have more influence. He had brought her here to Earth; and now his plan was to have Georg Brende and her fall in love with each other. He still hoped to win Georg to his cause, by giving him the Princess Maida if for no other reason. And with Maida married to Georg—and Georg in Tarrano's service—Maida herself would turn her influence in Venus to consolidate her people to Tarrano.

These, in part, were Tarrano's present plans and motives. They were working out well. And—as he had said—the Earth did not concern him now as a battle-ground. Later . . . But even with this sudden insight which seemed to come to me, I was inadequate to grasp what later he was to attempt.

While thus occupied with my thoughts, we were steadily descending into the ground under Venia—dropping out of sight while above us, perhaps by now, the eager warcraft of Earth were overwhelming the city. Tarrano had not spoken; but when at last our little car bumped gently at the bottom, he said smilingly, "We are here, Lady Elza."

We left the car, and passed into a dim-lighted cavern. I saw a lateral black tunnel-mouth yawning nearby, with a shining rail at its top and bottom, one above the other. And between the rails was a metal vehicle. A long, narrow car; yet with its turtle-back and its propelling gas-tube at the rear, with a rudder on each side of the tube, I realized that it was designed also for sub-sea travel. A small affair. Ten feet at its greatest width, and fifty or sixty feet long.

There was nothing startling in this evidence of underground and sub-sea transportation. But that it should be here in primitive Venia surprised me. Then I realized that Tarrano had been here perhaps many months. Quietly, secretly he had constructed this underground road. For his escape, I could not doubt it. Indeed, I did not doubt but that the man had anticipated practically every event which had occurred.

We found in the car, or boat if you will, a variety of attendants and personal belongings. Tara was there; I saw her sitting alone on one of the distant rings of seats. And Argo was among us—and others whom I had learned to know by sight and name. It was the party and equipment which Tarrano had probably originally brought with him from Venus. We, the last arrivals in the car, took our places. The doors slid closed. The car vibrated slightly; purred with its forward motors. We were started.

It was not a long trip. How far we went I have no means of knowing. But after a time, by the changed motion and sounds, I realized that we were traversing water. Then above us after another interval, they opened a hatchway. The pure fresh air of night streamed in upon us. Every light in the boat had been extinguished. At Tarrano's command I followed him up the small spider incline and through the hatchway. We stood on a little circular space of the turtle-deck, well aft—an observation space enclosed by a low metal rail. A few feet below us dark glassy water was slipping past.

At a lazy hasteless pace, we were passing along what I saw to be a broad river. The Riola Amazonia* I afterward learned it to be. Heavy banks of luxurious foliage, dark and silent. Inundated in places. And after a few moments we slackened, turned sharply into one of the inundated coves and nosed slowly amid a tangle of the jungle bank.

And then I saw, hidden here in the recesses of this pathless forest, a small interplanetary flyer, painted a hazy grey-blue. Around and over it the vegetation had been carefully, cunningly trained. A few cautious lights illumined it now; but without

A grey ball, changing to a glowing, vaguely dull red; then silver. . . . We were in the realms of outer, interplanetary space!

them, and even in daylight, I knew that from above it could never be seen.

Our party entered it—a small but surprisingly luxurious vessel. The foliage from above it was cut away by ready workmen; and in half an hour more we were rising from the forest. Straight up, into that cloudless sky. The land dropped away beneath us; visually concave at first as the circular horizon seemed to rise with us. The sky overhead fortunately was empty—nothing in sight to bar our outward flight. And we carried no lights.

In a moment or two, so swiftly did we gather velocity, the lights of Venia—a distant patch of them—were visible. Then, further away, I presently saw the grey expanse of open sea. And as we mounted, the simulated concavity of the Earth turned convex. I had never seen it thus—had never been so far above its surface before. A huge grey ball down there which was our Earth. Outlines of sea and land. Then continents and oceans, enveloped by patches of cloud area. A grey ball, changing to a glowing, vaguely dull red; then silver. Dwindling—gleaming brighter silver on one side where the sunlight struck it.

We were in the realms of outer, interplanetary space!

CHAPTER XVI

The Playground of Venus

After a trip uneventful—save that to me, taking it for the first time, it was an experience never to be forgotten in a lifetime—we landed at the Great City of Venus. We had sent no messages during the trip, and with our grey-blue color, I think we escaped telescopic and even radio observation

(*Continued on page* 861)

INVENTOR OF "DEATH RAY" RETURNS

H. Grindell Matthews, a British scientist, many months ago announced the perfection of the so-called "death-ray," and his name is now a by-word in practically every home in this country. In the February issue of this magazine an article will appear which is the result of a personal interview with Mr. Matthews at his experimental laboratory in Long Island. Mr. Matthews has developed several unusual and new scientific instruments, and the details of all of them will be given in both written descriptive and pictorial form. Don't miss it!

There was a sudden soundless flash. From across the room a beam of violet flame darted at us. It struck just between Maida and Wolfgar, as he rose from his knee. Both of them involuntarily stepped backward, apart from each other. And between them, breast high, the flame hung level. . . .

* Evidently the upper Amazon.

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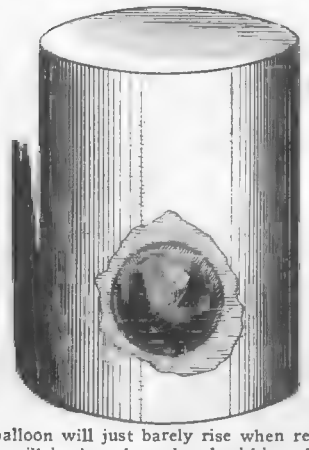
Scientific Problems and Puzzles

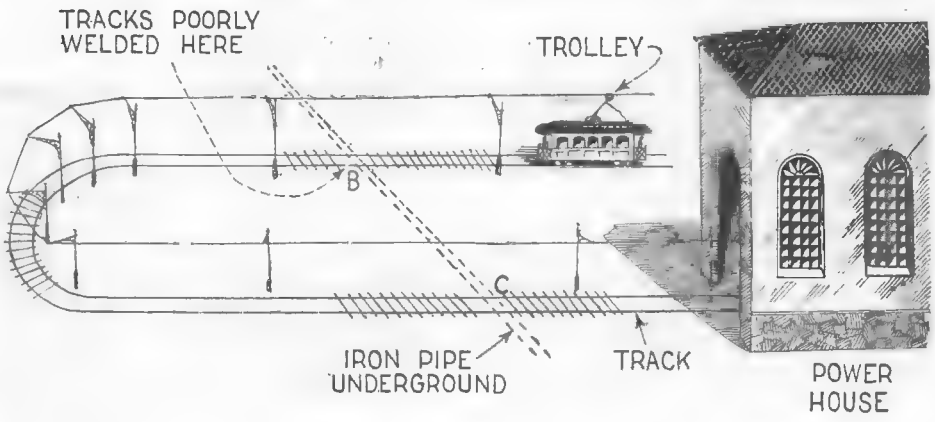
By ERNEST K. CHAPIN

BALLOON QUESTIONS



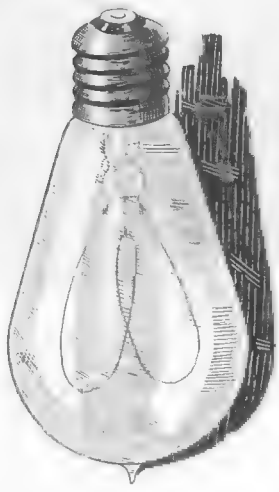
If a balloon will just barely rise when released in air, will it rise when placed within a hydrogen-filled case?

DIRECTION OF ELECTRICAL CURRENT



If the underground pipe in the above diagram corrodes at point C, due to electric currents set up in it by the trolley system, which way is the current flowing in the system?

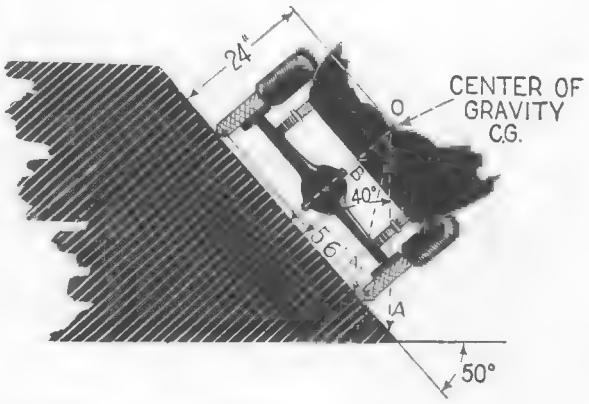
DARKENED LIGHT BULB



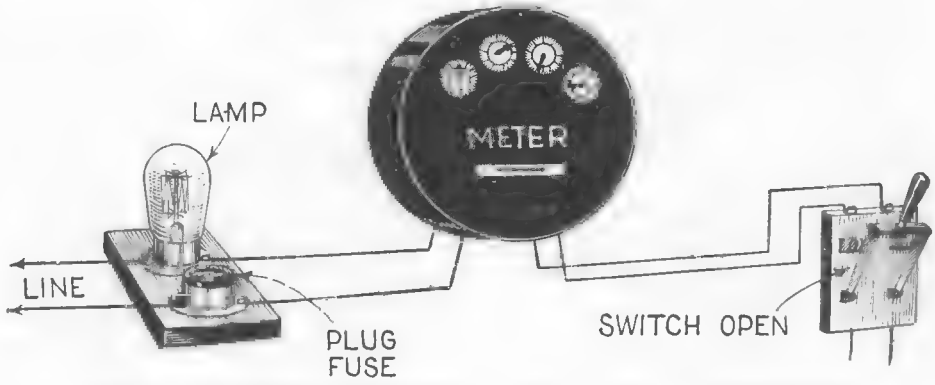
What is it that causes an electric light bulb to darken after it has been in use for some length of time?

CENTER OF GRAVITY

With wheels 56 inches apart and the center of gravity 24 inches above ground, would a car tip over if it ran on a bank with a slope of 50° to the horizontal as at right?

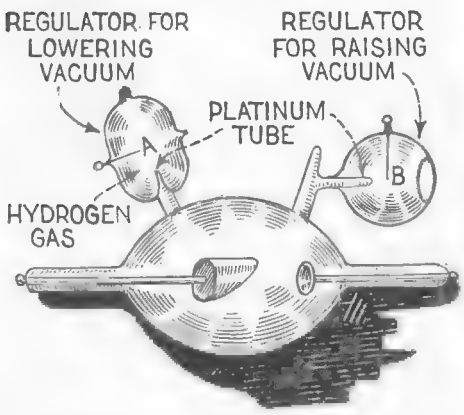


ELECTRICAL CIRCUIT



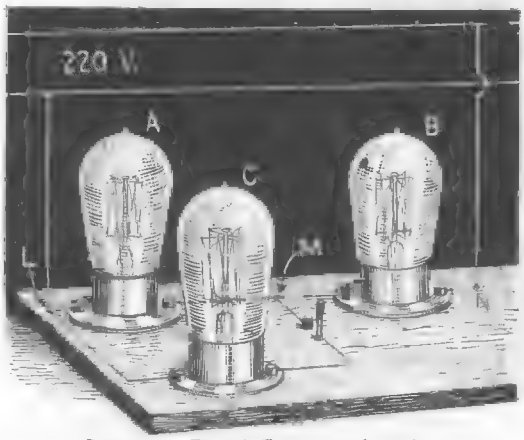
With a lamp and fuse in the input circuit to a meter, as above, can the lamp light?

X-RAY TUBE REGULATOR



Electric discharge between A and adjacent platinum tube lowers vacuum in main bulb. Between B and platinum tube, raises the vacuum. Why is this so?

LAMP PROBLEM



Lamps A, B and C are rated at 110 volts. Which, if any, will burn brightest?

OPTICAL QUERY

As above, what causes the striations that appear on a window screen viewed against the background of a window pane?

(*Answers to these problems given on page* 870)

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Artificial Ice for the Movies

No doubt many times you have watched movie stars performing on vessels covered with snow and ice, and you have wondered how the actors and actresses could stand the cold, while wearing flimsy garments. Possibly you have also seen the heroine of a play dive from the deck of a vessel into water full of floating cakes of ice. If this sent a chill down your spine, don't let it do so again. The players were just as warm as you or I on a summer's day, and the ice is merely paraffin floating on the surface of the water. In the photo above ice is being "made," by pouring hot paraffin into the water, the wax immediately solidifying. Photo at the right shows what it looks like in the film.

$5,000.00 Prize "Matchcraft" Contest

FOR the next twelve months, SCIENCE AND INVENTION magazine will award a total of $5.000 in prizes, in a new contest. You are asked to make models, fashioning the same entirely from safety matches. Please read the text of the Matchcraft article carefully and observe the following simple rules:

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting aud made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a photograph (large-sized) of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

16 Monthly Prizes

First Prize	$100.00
Second Prize	75.00
Third Prize	50.00
Fourth Prize	35.00
Fifth Prize	25.00
Sixth Prize	20.00
Seventh Prize	15.00
Eighth Prize	12.50
9th to 16th Prizes of $10.00 each	$80.00

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, request that the actual model be sent in for inspection, paying transportation charges both ways.

(10) This is a monthly contest, lasting for twelve months, each monthly contest closing on the first of the month following date of issue. This contest for the month of January will close February 1, 1926, and prize winning announcements will be made in the April, 1926. issue.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) When photographs are submitted, it is necessary that they be at least 5" x 7", not smaller, and that your name and address appear on the back of each photograph.

(14) In this contest, manuscripts or description of the models are not required, unless the model contains something unusual requiring explanation. Keep all descriptions short.

(15) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 53 Park Place, New York.

A Sub-Tropical Valley Within the Arctic Circle

COL. J. SCOTT WILLIAMS of Montreal, Canada, arrived lately in Prince Rupert from an airplane exploration trip of a verdant valley, discovered by Fred Perry, of Vancouver. two years ago. Some remarkably rich samples of ore were obtained from the Indians. who declared that there was an abundance of metals in the district. The minerals were almost pure lead ore and gold nuggets.

The valley is described as absolutely subtropical. The phenomenon is accounted for by the presence of a large number of hot springs. These bubble up the year round and cause vegetation to grow to an astounding size.

The soil is very fertile. Flowers growing there in profusion include violets which are unsurpassed for size. Raspberries and other fruits develop to unbelievable proportions. Many animals, such as wood deer, not generally found in the north, are plentiful in the valley.

The aerial party, Colonel Williams said, ate potatoes which Perry, a previous solitary explorer had planted last year, indicating that the winter season is not sufficiently severe to kill seed.

The valley is on a tributary of the Laird River and the country is of such a rugged nature that it requires 42 days to make the trip to it on foot, whereas the trip by airplane was made in three hours.

Indians residing in the valley received a real thrill when Colonel Williams arrived and descended among them, for it was their first view of an airplane. Two of them and their dogs were, after a long effort, persuaded to go for a flight and, at its conclusion. became heroes to their tribe and now are regarded as supermen.

The trip in the "big bird," as they called it, was made to a village in 45 minutes, whereas they were used to making the trip on foot, taking five days to do so.

The machine flown by Colonel Williams is of the Vickers-Viking flying-boat type. He departed with it by steamer from Prince Rupert on June 11. Landing at Wrangell, he flew from there to Telegraph Creek, the gateway to the tropical valley, in three hours.

The plane flew 6,000 miles in the north and never suffered a mishap. The party went 200 miles into the Yukon north of Lake Francois and far down the Laird River until they reached the valley.

—Contributed by F. Gage Todd, Jr.

(EDITOR'S NOTE: *This report will prove of great interest to those who read our serial, "The Living Death," by John Martin Leahy, wherein authentic references are made to such a valley existing in the antarctic regions.*)

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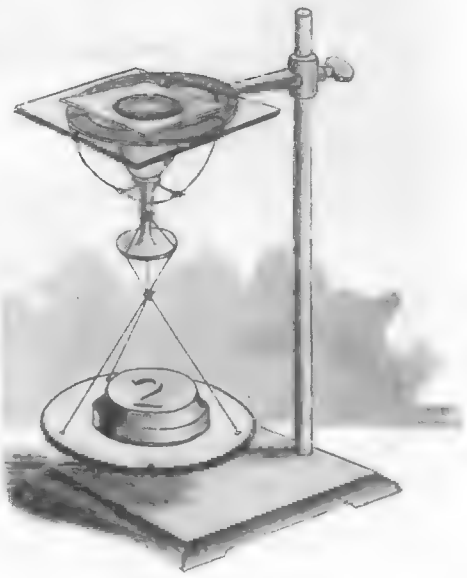
Odds and Ends of Physics

By T. O'CONOR SLOANE, Ph.D.

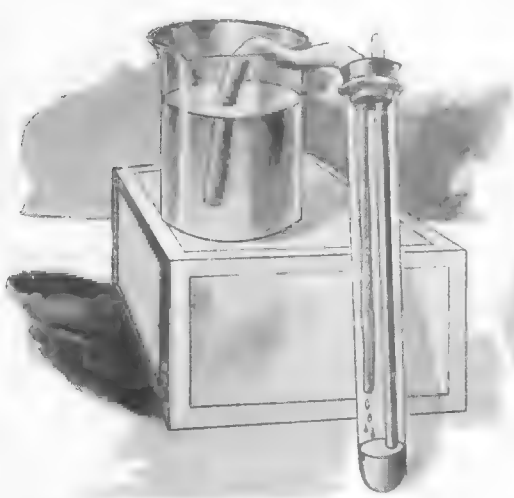
SURFACE tension is the action exerted between the molecules of a liquid on its surface. The same attraction exists throughout, but on the surface it is limited to three directions of pull. This causes the outer molecules to act as if they were a sheet of thin India rubber. The term "surface tension" is applied to the action.

ABOVE is shown the phenomenon of the tears of strong wine. A test of wine has been to partially fill a wine glass with it and shake it around so as to moisten the glass. Then on letting it stand a species of tears would form on the inside of the glass and would rapidly run down into the contents below. The illustration shows a mixture of alcohol and water with which a piece of glass is moistened. On exposure to the air the alcohol evaporates more rapidly than the water. The surface tension, as it is called, acts like an elastic membrane and pulls the water together into little streamlets which run down the glass, and are beautifully shown by letting a candle light shine upon them, so that they are depicted by their shadow on a sheet of paper.

The funnel and tube are placed with the lower end in mercury, then filled brimming full of water; a glass plate and a sheet of blotting paper are placed upon the funnel. By capillary action the blotting paper absorbs the water and the mercury rises in the tube.



A WINE glass or tumbler is filled brimming full of water. A plate of glass with a piece of dry blotting paper beneath it is placed firmly on the tumbler. It absorbs the water by capillarity producing a partial vacuum, as it is called. If this is carried out correctly a weight can be suspended from the tumbler, as shown. Note the string to catch the tumbler in case it falls. Capillarity is a distinct phenomenon of surface tension. In this and the preceding experiments, it is well to grind off the lip of the glass to a perfectly flat surface. Otherwise with an irregular lip the experiment will fail. The sheet of glass also must be perfectly true. It is even well to use a piece of plate glass, although double thick window glass will answer sometimes very nicely for the purpose.



Water is siphoned into a test tube with mercury in the bottom. When corked as shown, the pressure produced by the siphoning will cause the mercury to rise in the tube. A very nice variation of this experiment is to use a rather large tube for the siphoning and fill it with porous lamp wick or twine, so that the capillary action starts it going. A third variation is to siphon mercury from the beaker and note how it will raise a column of water in the other tube to a great height. Capillarity, as a word, is derived from the Latin word meaning a hair. It applies to the action of liquids in very narrow tubes; these are called capillary tubes. The action of lamp-wicks and of blotting paper are familiar examples of capillarity.

Water forms bubbles by a film of water forming and imprisoning air. We place mercury in a beaker, cover it with water, or perhaps better with a strong solution of sodium sulphate or similar salt, then on pouring mercury into it, mercury bubbles form on the surface of the metal of the beaker, each one a film of mercury, filled with a mass of the water or salt solution but true mercury bubbles. Each drop of mercury carries some water down into the metal bath. It instantly floats up and for a moment carries up a film or skin of metallic mercury, forming thus true mercury bubbles, each filled with water, as soap bubbles are filled with air. The bubbles are very short-lived, but the experiment is most interesting.

This is another version of the capillary siphon. A small beaker is floated inside a large one, and a cotton wick is placed as shown, dipping into the smaller beaker and also into the large one. By capillary action it absorbs the water from the outer vessel and presently the liquid descends where it dips into the inner one, and a siphoning effect is produced. The water siphons out from the large one into the small one; the latter keeps on sinking lower and lower, until perhaps it will sink to the bottom.

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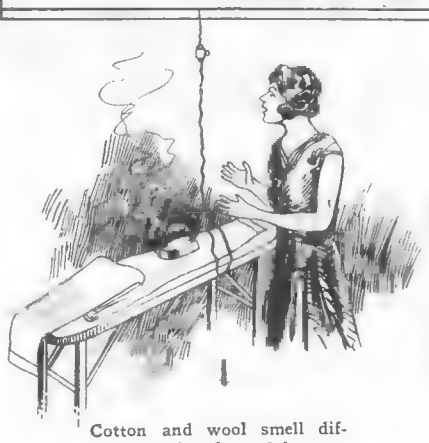
Everyday Chemistry

By RAYMOND B. WAILES



Cotton and wool smell differently when burned because of nitrogenous substances in wool.

A good black-face grease paint can be made by first rubbing cold cream into the skin and then applying a paste of lamp black and glycerine.

The storage battery fluids which are supposed to revive old batteries contain the usual acid, together with Epsom salts, alum and glycerine.

Ozonized turpentine makes the paint with which it is mixed dry quickly. It is turpentine which has been exposed to the air and sun light.

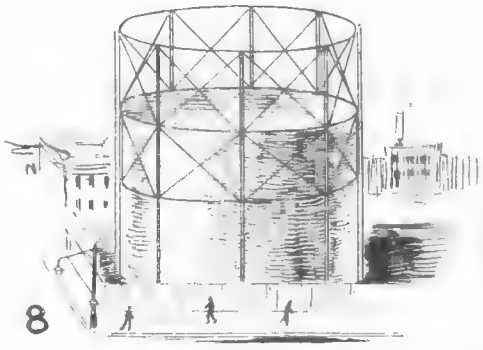
Facial clays usually contain alum, oatmeal, Fuller's earth, casein or all of them. Alum is an astringent, the earth and oatmeal absorb dirt and the casein opens the pores.

Silks which are weighted down with tin compounds actually wear out when exposed to sun light. The metal compounds react chemically with the silk fibres when in the presence of light.

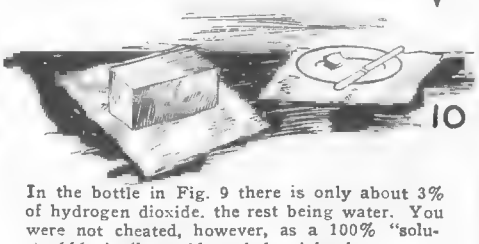
METHANOL = CH_3OH = WOOD ALCOHOL = METHYL ALCOHOL = WOOD SPIRITS = DEATH

7

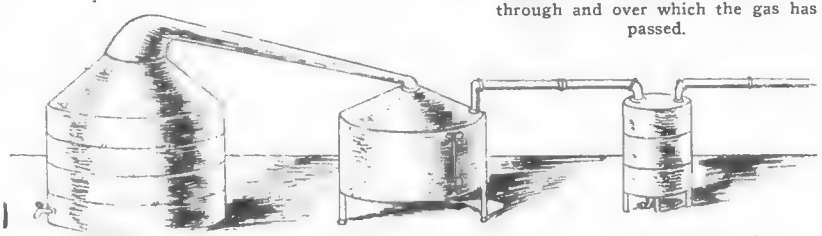
Fig. 7 is an example of chemical arithmetic. All of the terms shown mean the same thing. Butter, Fig. 10, keeps better if it is churned with carbon dioxide gas, inasmuch as that gas is not reactive with the butter and replaces the air which is the active spoiling agent.



The odor around gas houses, Fig. 8, is not usually gas but is from beds of exhausted purifying material; lime through and over which the gas has passed.



In the bottle in Fig. 9 there is only about 3% of hydrogen dioxide. the rest being water. You were not cheated, however, as a 100% "solution" would explode violently.



In distillation, the carbon dioxide gas evolved, which is a waste product, is recovered, purified, and compressed into cylinders for refrigeration.

Phosphate, one type of which is used at soda fountains, is also used in the Parkerizing process of rust-proofing steel.

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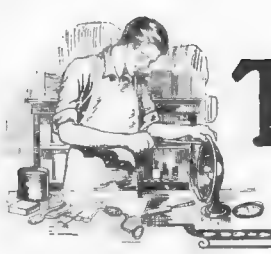
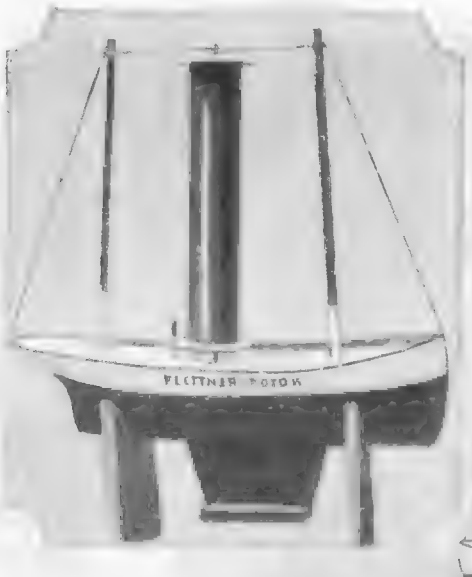
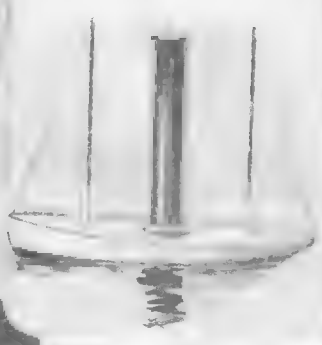
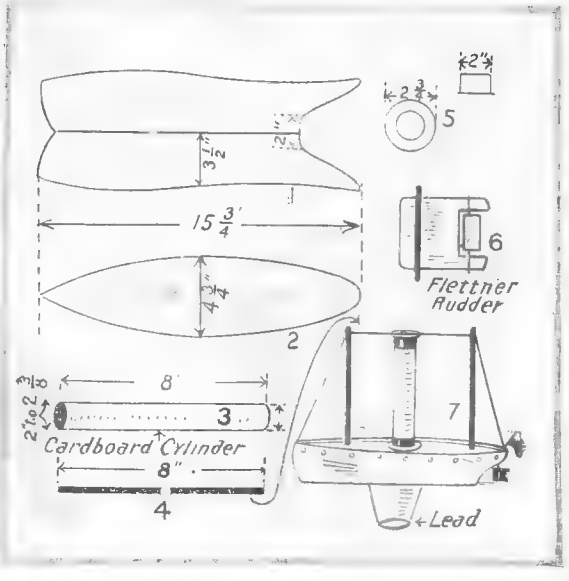


THE CONSTRUCTOR

A Model Rotor Ship







By exercising a little ingenuity, anyone at all handy with tools can build a working model of the famous Flettner rotor ship. The body is built of thin sheet metal, following the details given in 1 and 2 above. The seams are soldered so as to be watertight. A clockwork motor is used for revolving the cylinder and should be geared so as to produce about 250 revolutions per minute. The cylinder is made of cardboard and fixed to the clock mechanism by the washer, 5. The aluminum strip, 4, holds the rotor in position, its upper end supported as at 7. A Flettner rudder in which a small vane moves a larger one by water pressure may be constructed as at 6. Photos show other details of construction. —Ricardo Ludeke.

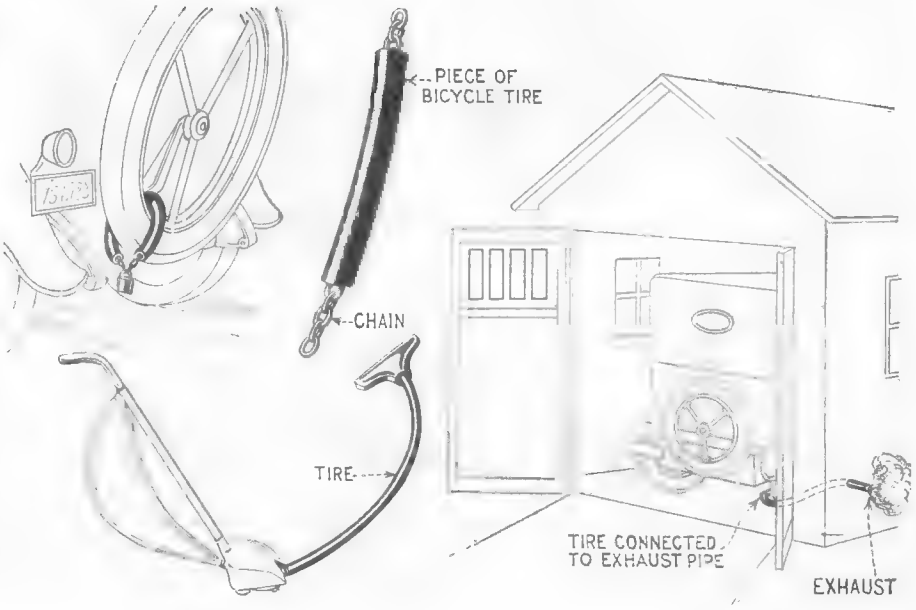
Uses for Bicycle Tires

OLD bicycle tires that have been discarded as being worthless for their original purpose can be put to many other uses and will be found most satisfactory. The illustration at the right suggests three different ways in which tires of this nature can be employed. The first is as a protection around a chain used for locking the spare tire of an automobile. Under ordinary conditions, a bare chain is very apt to chip or scratch the paint on the car. If, however, a section of bicycle tire is slipped over the chain and used as shown, no damage can be done.

A piece of tire that does not have too many air leaks in it can be put to use on the vacuum cleaner and used as an extension hose so that the nozzle can reach out of the way places.

Running the engine of a car in a closed garage is often the cause of death, due to the carbon monoxide liberated from the engine exhaust; this gas can be piped to the outer air by means of an old bicycle tire slipped over the exhaust pipe and projecting through a hole in the wall.

—*H. E. Wenrich.*



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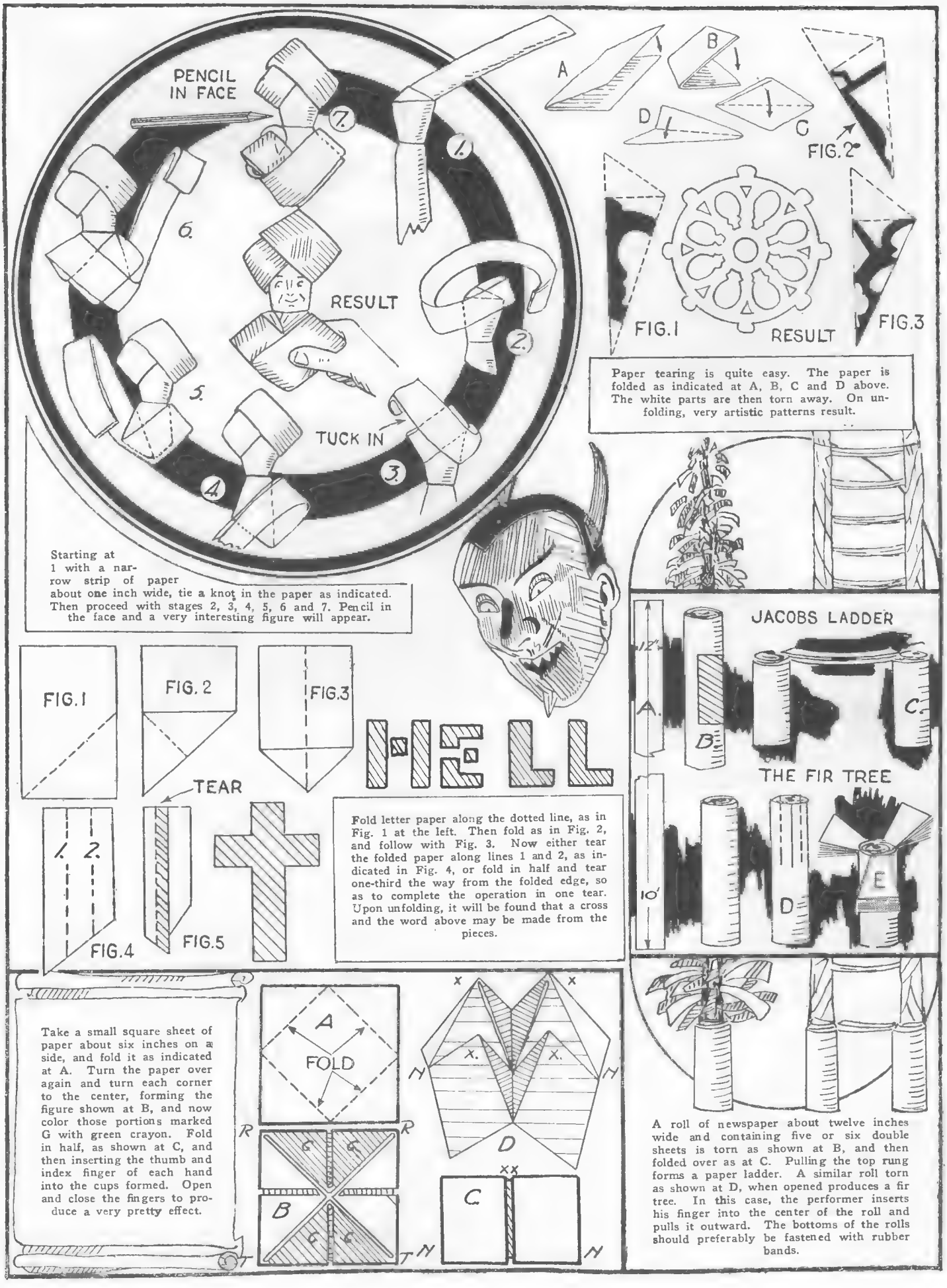
Paper Tricks

By JEAN IRVING



Starting at 1 with a narrow strip of paper about one inch wide, tie a knot in the paper as indicated. Then proceed with stages 2, 3, 4, 5, 6 and 7. Pencil in the face and a very interesting figure will appear.

Paper tearing is quite easy. The paper is folded as indicated at A, B, C and D above. The white parts are then torn away. On unfolding, very artistic patterns result.

Fold letter paper along the dotted line, as in Fig. 1 at the left. Then fold as in Fig. 2, and follow with Fig. 3. Now either tear the folded paper along lines 1 and 2, as indicated in Fig. 4, or fold in half and tear one-third the way from the folded edge, so as to complete the operation in one tear. Upon unfolding, it will be found that a cross and the word above may be made from the pieces.

Take a small square sheet of paper about six inches on a side, and fold it as indicated at A. Turn the paper over again and turn each corner to the center, forming the figure shown at B, and now color those portions marked G with green crayon. Fold in half, as shown at C, and then inserting the thumb and index finger of each hand into the cups formed. Open and close the fingers to produce a very pretty effect.

A roll of newspaper about twelve inches wide and containing five or six double sheets is torn as shown at B, and then folded over as at C. Pulling the top rung forms a paper ladder. A similar roll torn as shown at D, when opened produces a fir tree. In this case, the performer inserts his finger into the center of the roll and pulls it outward. The bottoms of the rolls should preferably be fastened with rubber bands.

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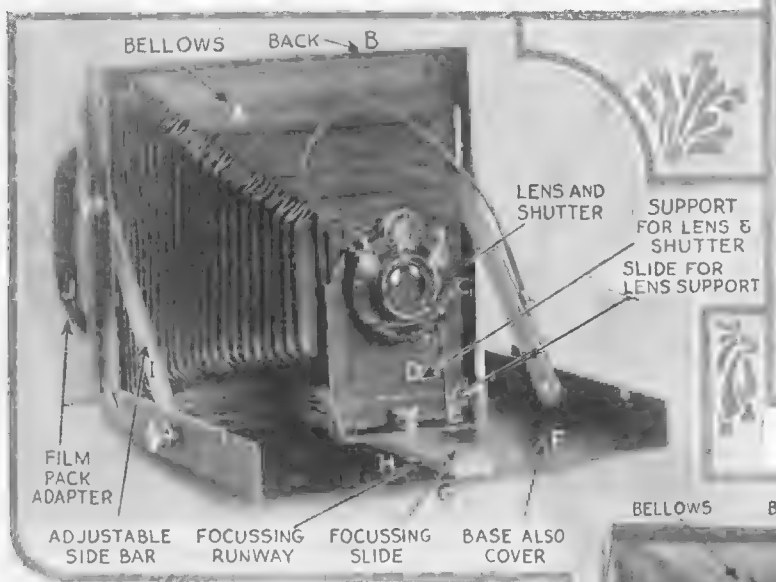
A Home-Made Compact View Camera

By S. I. PHILLIPS

The completed view camera set up and ready for action is illustrated in the photograph below. Note method of supporting lens.

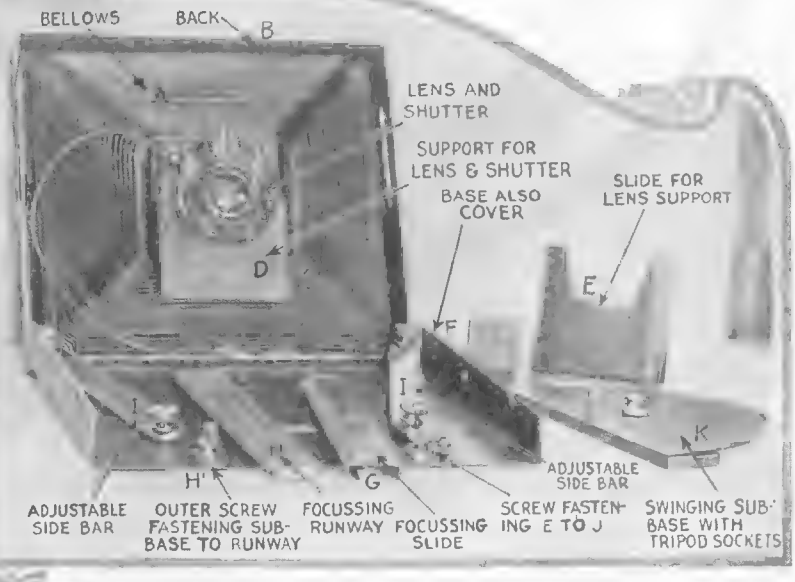


Above: The view camera folded up showing swinging tripod support and how base of camera is the cover when folded.

The film pack case illustrated below slides into grooves in the back of the camera that are detailed on the next page. The pack holder itself is of the manufactured type but is reconstructed so as to adapt itself to this particular camera.

SHEET METAL SCREWED TO FACE WITH OVERLAPPING EDGES TO SLIDE IN BACK OF THE CAMERA
GROUND GLASS IN SLIDING FRAME
L
PROTECTING COVER
J'
FILM PACK ADAPTER

So as to facilitate focusing, ground glass is provided that can be slipped into the back of the camera in place of the film pack. The glass is protected during transportation by a sheet metal cover.



The photograph above shows all of the details of the various parts of this camera that go to make up the lens support and its adjustable rack, as well as the side supports which hold the base and back at right-angles to each other. All of the specially shaped parts were made by the author.

THE AUTHOR of this article has constant use for a camera that will take a comparatively large picture, yet the average view camera is so bulky that it is always in the way. Therefore, he set about designing and building a camera that would fit his particular use and the result was so good that the details are being passed on here to our readers. When the camera is completely folded, it takes up a space only slightly larger than the film pack which holds 5 × 7 inch films and is slightly over 1 inch thick. Together with a telescopic tripod, the film pack adapter, focusing cloth and other necessary accessories, the camera can be packed in an ordinary brief-case without making any unsightly bulges.

Usually when cameras are made to take up a very small space, many valuable features are sacrificed. However, in this particular case, all of the standard view camera adjustments are found. A long extension bellows, a rising and falling front, a swinging front and a tilting and swinging back are all present.

By studying the photographs and diagrams on this and the opposite page, any amateur mechanic who is handy with tools can duplicate this camera with little trouble. No special tools are necessary and the writer did the entire job without recourse to machine work of any kind. The first step, before you even attempt to build the camera frame and base, is to buy a good lens with shutter and a bellows. Judicious shopping around second-hand camera stores will soon bring to light the required parts. Buy as good a lens as you can possibly afford as upon this the success or failure of your camera depends When buying these parts, obtain a standard film pack adapter. With these on hand, you are ready to design your own camera and make the various parts fit perfectly. Because of the variations in lenses and bellows, only a few definite dimensions are given in this article. Therefore, it is advisable to follow the general procedure outlined in order to avoid future trouble, changing the dimensions to suit. On the opposite page will be found a list of parts, the letters on which correspond with those on the photographs and drawings. It is advisable to get all of the various parts and raw materials together before going on with the work. Then you can lay everything out and go right ahead without having to stop for more or different materials.

It will be well to observe certain rules of order when starting to make this camera. For instance, lay out all your work in theory and on paper before you even begin to make any special part of the camera. Review the situation thoroughly, study the photographs and diagrams given in this article and make any additions or changes to them that may appear necessary, due to the particular sizes of parts that you may purchase. It is obvious that a camera design of this nature is very flexible and if the reader does not desire a camera as large as this one, the same principles outlined can be applied to the construction of a 4" x 5" camera, that will be even smaller and more compact.

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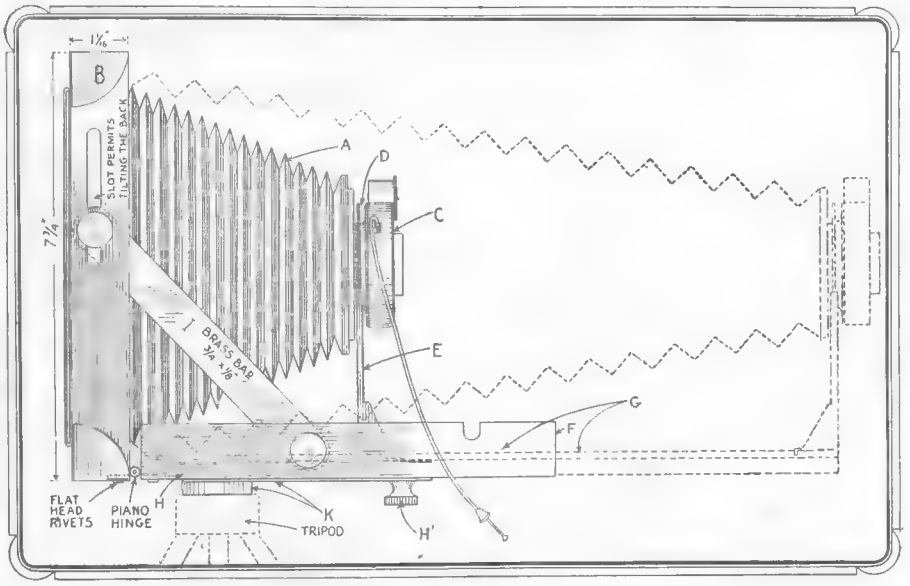
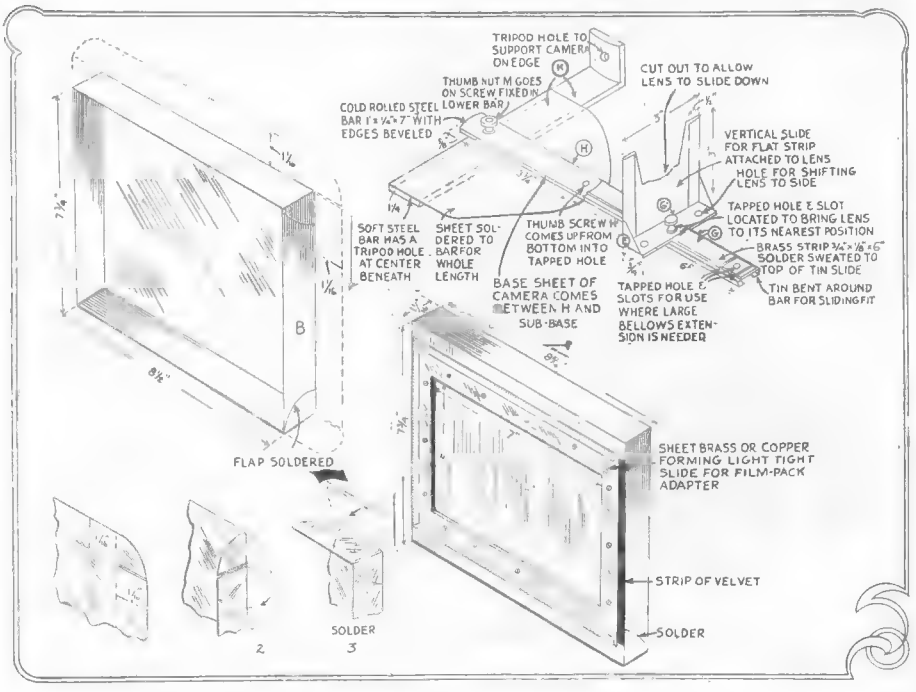
THE following parts are necessary for making this camera. Letters preceding parts correspond to those on photos and drawings. A, bellows which should cover 5" x 7" film and extend 15 inches or the distance required by lens. B, back made of heavy gauge galvanized iron as below, C, lens and shutter. D, support for lens and shutter made of sheet iron. E, slide for lens support. Details below. F, base, also cover. Bend from heavy gauge galvanized iron and drill hole for screw on K, and slot for side swing screw, H'. G, focusing slide. Bend from thin sheet metal to fit H. Solder strip of brass on top, drilled and slotted as below. H, focusing run-way. Cut from 1 inch by ¼ inch cold rolled steel strip and drill as shown below. I, adjustable side bars of brass strip, drilled and tapped. J, film pack adapter with sheet metal face. K, swinging sub-base. Details below. L, ground glass mounted as shown on opposite page. A careful study of the diagrams below and to the right will aid materially in building a camera similar to this one.




TRIPOD HOLE TO SUPPORT CAMERA ON EDGE
THUMB NUT M GOES ON SCREW FIXED IN LOWER BAR
COLD ROLLED STEEL BAR 1" x ¼" x 7" WITH EDGES BEVELED
CUT OUT TO ALLOW LENS TO SLIDE DOWN
VERTICAL SLIDE FOR FLAT STRIP ATTACHED TO LENS
HOLE FOR SHIFTING LENS TO SIDE
TAPPED HOLE & SLOT LOCATED TO BRING LENS TO ITS NEAREST POSITION
BRASS STRIP ¾" x ⅛" x 6" SOLDER SWEATED TO TOP OF TIN SLIDE
TIN BENT AROUND BAR FOR SLIDING FIT
SOFT STEEL BAR HAS A TRIPOD HOLE AT CENTER BENEATH
SHEET SOLDERED TO BAR FOR WHOLE LENGTH
THUMB SCREW H COMES UP FROM BOTTOM INTO TAPPED HOLE
BASE SHEET OF CAMERA COMES BETWEEN H AND SUB-BASE
TAPPED HOLE & SLOTS FOR USE WHERE LARGE BELLOWS EXTENSION IS NEEDED
FLAP SOLDERED
SHEET BRASS OR COPPER FORMING LIGHT TIGHT SLIDE FOR FILM-PACK ADAPTER
STRIP OF VELVET
SOLDER
SOLDER
2
3

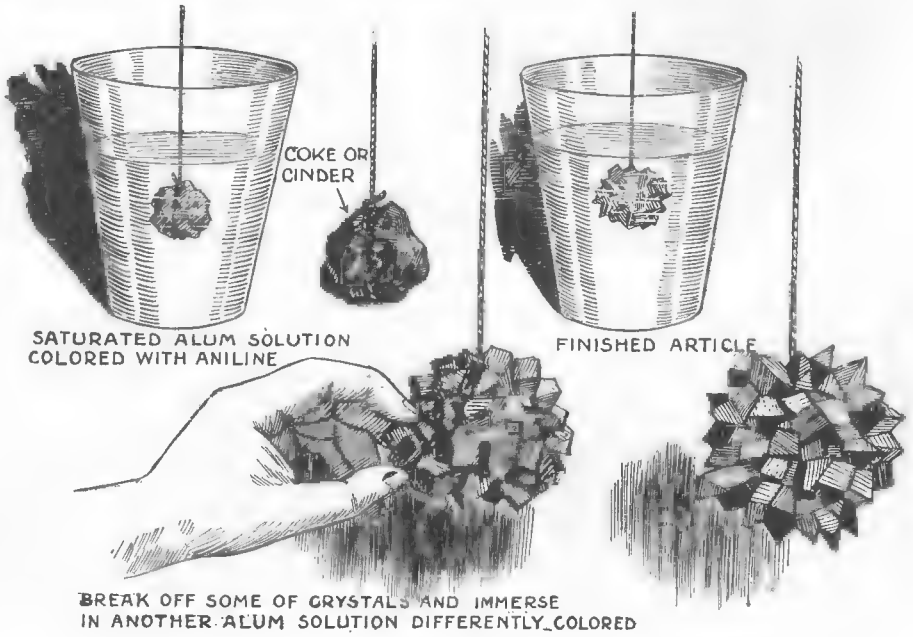
In the illustration above, a side view of the camera is shown. The dotted lines indicate the position of the bellows, the lens and the focusing rack when the long extension bellows is being used. This is necessary in photographing small objects close to the camera.

In making the back of the camera into which the film pack adapter or ground glass is to slide, the edges should be cut and folded as shown in the lower left-hand corner of the diagram at the left. Soldering will complete each corner. To the back of this shallow box so formed, screw the sheet brass strips folded over at the edges so as to form a run-way for the film pack holder. Strips of velvet are used to exclude light.

The various thumb nuts and thumb screws used in this assembly are of standard sizes and may be readily purchased. They permit variations in the positions of the parts of the camera and make the entire outfit most flexible. The details in the upper right-hand corner of the illustration at the left shows the uses to which the thumb nuts and screws are put. Further information can be gleaned from the above diagram. Paint the finished camera black to improve appearance.

How to Make Colored Crystals

IT is well known that beautifully formed crystals can be made by hanging pieces of coke or cinders in a saturated solution of alum. We can, however, go a step further than this and obtain beautifully colored crystals if we add an aniline dye to the alum solution. With a little care, crystals with two or more bright shades of color may be obtained. First prepare several alum solutions by adding as much alum to boiling water as can be dissolved. Color the different solutions strongly with dyes. Suppose that you make up a blue, a red and a yellow solution. Hang the coke or cinder in the red liquid and allow it to remain there until a large series of crystals is formed. Remove from the solution and break away several of the moist crystals. Allow the mass to dry and hang in the blue solution. Crystals will only be deposited on the exposed rough parts of the coke and they will be of a different color. Repeat the same procedure and use the yellow solution. You will then have a gleaming mass of crystals having three separate and distinct colors throughout. Do not forget to let each series of crystals dry before placing in the next solution.—S. Leonard Bastin.


COKE OR CINDER
SATURATED ALUM SOLUTION COLORED WITH ANILINE
FINISHED ARTICLE
BREAK OFF SOME OF CRYSTALS AND IMMERSE IN ANOTHER ALUM SOLUTION DIFFERENTLY COLORED

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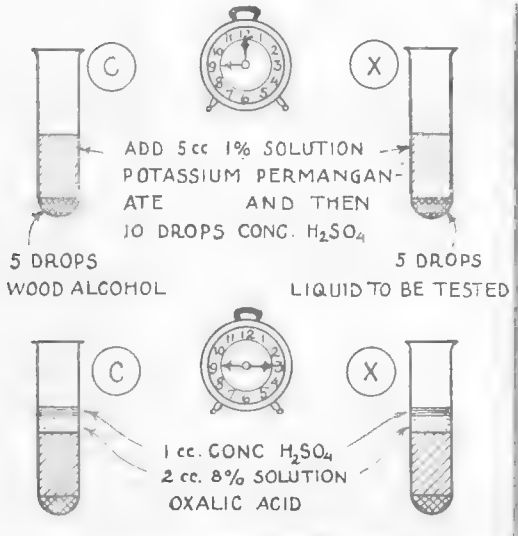
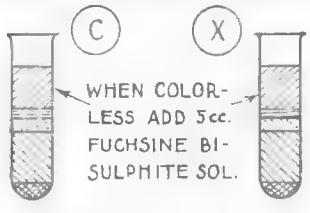
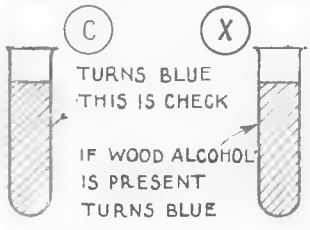
A Reliable Test for Wood Alcohol

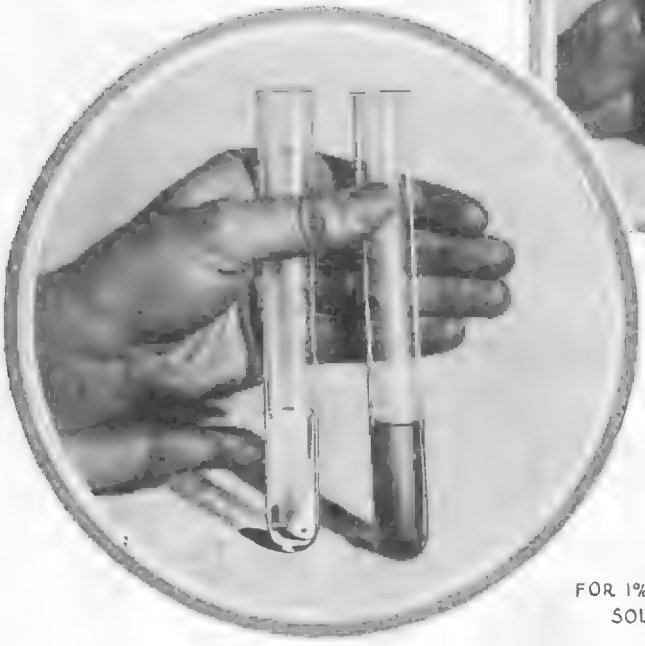
By RAYMOND B. WAILES

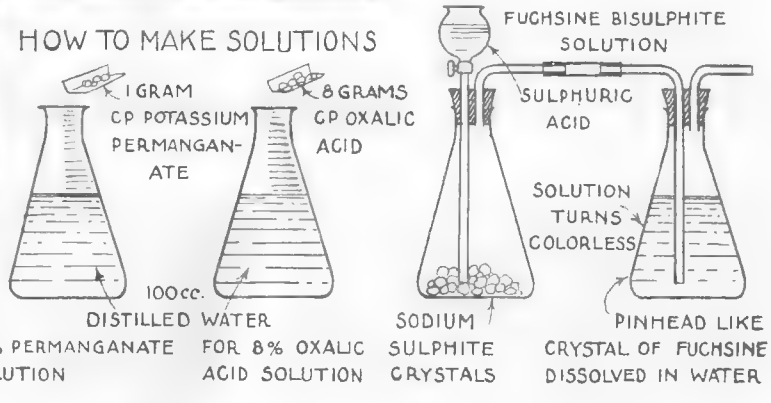
MANY are the requests that have been received by this magazine for accurate and reliable tests for the presence of wood alcohol in grain alcohol or other liquids. A test of this nature is highly desirable both in chemical laboratory and in every-day life. We are presenting on this page complete and authoritative directions for the application of such a test. This particular one is even more sensitive than is required to detect one part of wood alcohol in 20,000 parts of a liquid. The chemicals that are used are not hard to obtain and can be purchased at the corner drug store. The illustrations give complete procedure and all of the necessary information and details will be found below.


C
X
ADD 5cc 1% SOLUTION POTASSIUM PERMANGANATE AND THEN 10 DROPS CONC. H_2SO_4
5 DROPS WOOD ALCOHOL
5 DROPS LIQUID TO BE TESTED








HOW TO MAKE SOLUTIONS
1 GRAM CP POTASSIUM PERMANGANATE
8 GRAMS CP OXALIC ACID
100cc. DISTILLED WATER
FOR 1% PERMANGANATE SOLUTION
FOR 8% OXALIC ACID SOLUTION
FUCHSINE BISULPHITE SOLUTION
SULPHURIC ACID
SOLUTION TURNS COLORLESS
SODIUM SULPHITE CRYSTALS
PINHEAD LIKE CRYSTAL OF FUCHSINE DISSOLVED IN WATER

TO PERFORM this test, place five drops of wood alcohol in a test tube marked C, and 5 drops of the colorless liquid to be tested in a test tube marked X. Add five cc. of a 1% solution of potassium permanganate and ten drops of strong sulphuric acid to each of the tubes. Allow to stand for 15 minutes. Now add to each tube, two cc. of an 8% solution of oxalic acid and also one cc. of strong sulphuric acid. Allow both tubes to become decolorized before proceeding. When colorless, add five cc. of fuchsine bisulphite solution, made as below, to both tubes. The contents of tube C will turn from colorless to blue in several minutes because wood alcohol is actually in this tube. If tube X becomes blue, there is wood alcohol in the substance tested. If the liquid in tube X does not turn, and that in tube C does, there is no wood alcohol in the liquid under test. Tube C is merely used to check the chemicals and the person making the test.

How to make the solutions used: 1% potassium permanganate solution. Dissolve 1 gram of CP potassium permanganate in 100 cc. of water. 8% oxalic acid solution: Dissolve 8 grams of CP oxalic acid crystals in 100 cc. of water. Fuchsine bisulphite solution: Use the apparatus shown above. In the left flask place some sodium sulphite crystals and drop some sulphuric or muriatic acid into funnel. When the stopcock of the funnel is opened, sulphur dioxide gas will be generated and will bubble through the solution in the right-hand flask in which is a solution of a fuchsine crystal as large as a pinhead dissolved in the amount of water shown in the 100-cc. flask. The solution will turn from red to colorless and is to be used as the fuchsine bisulphite solution.

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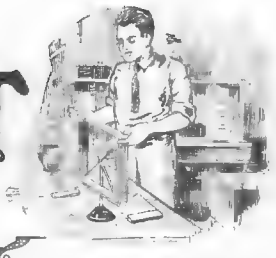
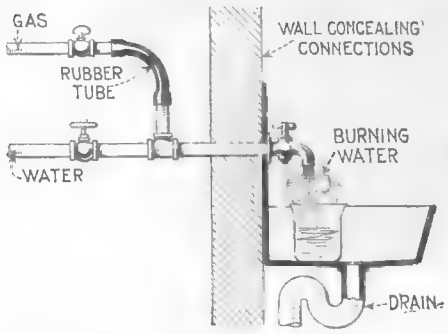
HOW TO MAKE IT

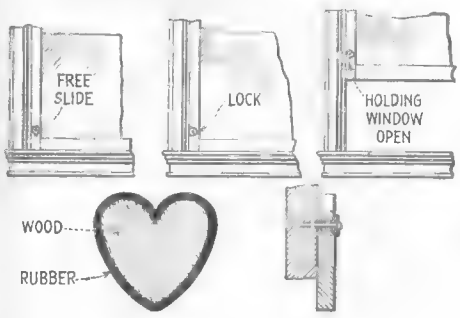


Burning Water



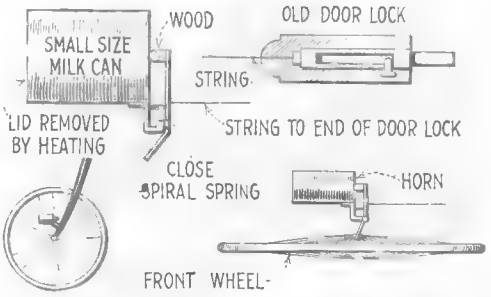
By connecting a gas and water pipe together and allowing both to issue from a faucet as above, the gas can be ignited with a match giving the effect of water burning. This is a good window display. —Carlyle Weiss.

Window Latch



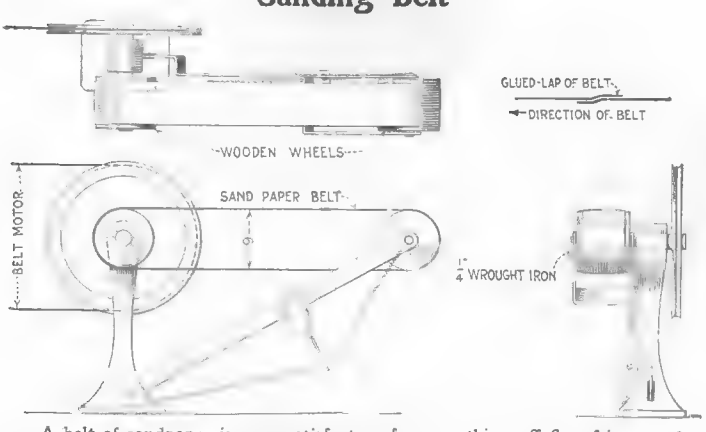
A heart shaped block of wood with a strip of rubber secured to the edge as above, makes an excellent window latch for holding the window closed or open as illustrated. The block is pivoted on a nail as shown. —L. D. Starcher.

Bicycle Horn



A siren for a bicycle can be made from an old tin can with the attachment shown. The door bolt or door lock shown is for the purpose of holding the striking element away from the can or by releasing it, the siren is made to operate. It is actuated by the spokes striking the lever. —Aurelio Rivera.

Sanding Belt

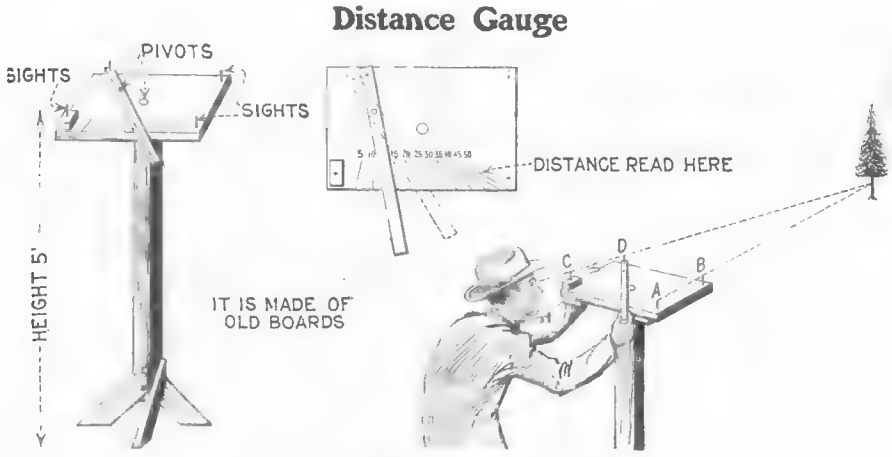


A belt of sandpaper is very satisfactory for smoothing off flat objects and one can be readily attached to a motor-driven emery wheel by making up the bracket illustrated in detail above. The belt of sandpaper runs over two large pulleys which can be turned off on a lathe or cut from a wooden cylinder 4 inches in diameter. —William White.

Lighting Inaccessible Parts

If a beam of light enters the end of a solid glass rod, it will follow that rod, even though it be bent. This behavior can be employed for lighting inaccessible parts by means of the arrangement shown above. A source of light is focused on the end of a bent glass rod through a lens of the size shown. A quartz rod is ideal. —C. A. Oldroyd, Rep. No. 4433.

Distance Gauge



If a "distograph" is made up as detailed above and calibrated by actual measurement, it can be used for measuring distances directly. Sight on the object along the two pins at the edge of the board and then holding the board steady, move the pivoted rod and sight along points C and D. The distance will then be indicated on the scale. —Francis Boyd.

Ink Stands

A handy ink and pen stand can be cut from a sheet of fairly heavy cardboard by following the details given above. After being bent to shape, it is held with paste or glue and the bracket shown. —Hubert Slouka, Rep. No. 7110.

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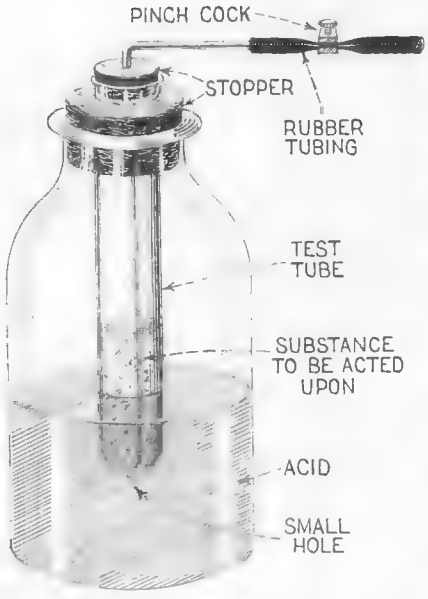
WRINKLES
RECIPES & FORMULAS

Edited by S. Gernsback

Synthetic Gold Bronze

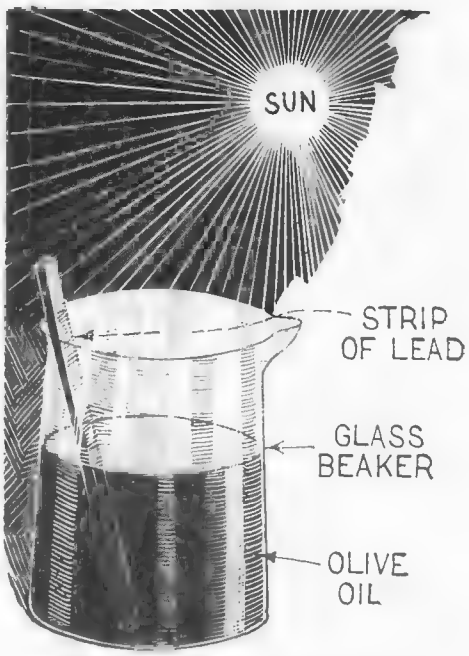
If a solution of copper sulphate and sal ammoniac is mixed with ammonium vanadiate and the mixture is carefully heated over a Bunsen burner, a compound of a splendid gold color will be deposited from the liquid in the form of yellow spangles which do not change on exposure to air, and which in every respect equal genuine gold bronze for artistic purposes.
—Gordon M. Smith.

Gas Generator



When a solid is to be acted upon by an acid in order to produce a certain type of gas, the automatic generator illustrated above may be used. The test tube is filled with the solid and then held by a perforated cork in the bottle as shown. The acid, entering through the small hole in the bottom of the test tube generates gas, which is delivered through the glass tube. When the pinch cock is closed, the pressure of the gas accumulating in the test tube, forces the acid out of that tube and back into the flask, thus stopping the action, which can be renewed at any time. —Robert Coltman.

Watch Maker's Oil

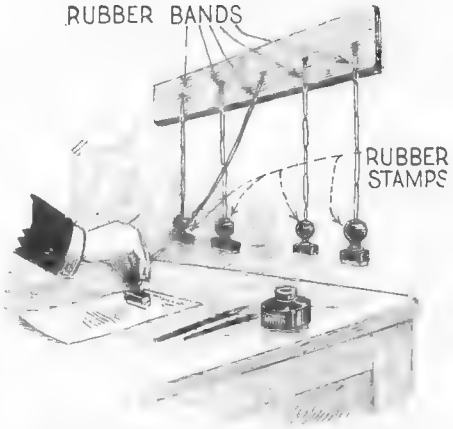


A fairly good grade of oil for use on watches and light machinery can be made by placing a strip of lead in a squall quantity of olive oil and exposing to the sun's rays for a considerable length of time. The action should be allowed to continue until the semi-solid mass ceases to be deposited in the beaker and the olive oil becomes quite limpid in character.
—F. R. Moore, Rep. No. 1993.

Dog Feeder

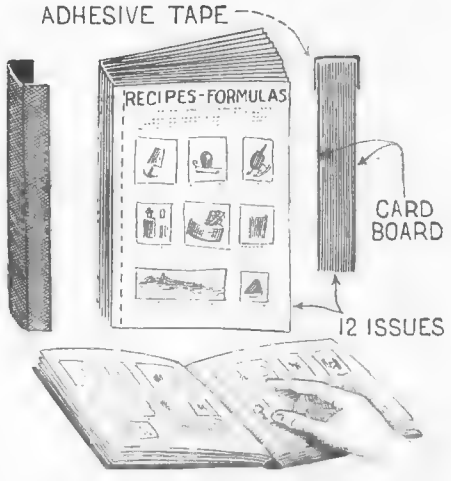
When the family is out for an entire day, the pet dog must go without a meal or else must be fed his entire day's rations at once. With the device shown above, he may be fed at the regular time. A string attached to the alarm key of a clock is looped over a dog biscuit placed in some position not accessible to the dog and the alarm is set. When it rings, the string is wound up and the dog biscuit is pulled off the shelf and falls upon the floor. —Leo Preston.

Rubber Stamp Holder



Where several rubber stamps are constantly in use, they are usually all over in the way and never seem to be at hand when needed. If, however, an arrangement such as that illustrated above is made, the stamps will always be at hand and will always be in place when they are wanted. Several rubber bands are linked together and one end of the resulting chain is fastened to the wall. The other end is attached to a rubber stamp, which then hangs in position in back of the desk. When it is wanted, the rubber band stretches and allows the stamp to be used.
—Franklyn Kenchion.

Reference Book



The writer finds it very convenient to clip the different departments such as this one, the "How-to-Make-It" and "The Constructor" from the pages of SCIENCE AND INVENTION Magazine, and bind them together as illustrated above. A piece of adhesive tape is placed over the left-hand edge of the assembled sheets and bent over on the sides so as to form a substantial binding. By dividing the departments as mentioned, the bound sections will form handy references to any particular subject desired.—F. J. Wilhelm.

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SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 53 Park Place, New York City.

HAS THE EARTH TWO MOONS?

Editor, SCIENCE AND INVENTION:

In the May issue of SCIENCE AND INVENTION, Don Home discusses the question "Has the Earth Two Moons?" and comes to the conclusion that it has not. He believes that a second moon at the distance that it is supposed to be could not long remain undiscovered, even if as small as 500 feet in diameter. It is suspected to be at a distance of about 2,500 miles. The discovery of a small body at that distance would be no easy matter. It would be more quickly seen if at a greater distance from the earth. (*No.*—EDITOR.)

A satellite at a distance of 2,500 miles from the earth would complete a revolution in about three hours. If its direction of motion was the same as that of the planets and the moon, it would rise in the west and set in the east. Such a satellite could never be seen "full" from the earth. In 25 minutes after the first quarter it would enter the earth's shadow and would not reappear until 25 minutes before the last quarter. It could be seen to the best advantage only a few minutes before entering or after leaving the earth's shadow, and when overhead at the same time. The chance for an observer being in the most favorable locality is small; and the chance for him to be looking at the right place in the sky, still smaller? (*Question mark ours. It would be favorable for any part of earth between X and B.*—EDITOR.)

It might be seen while crossing the sun's disk, for it would transit the sun in every revolution from some place on the earth's surface, unless the inclination of its orbit was very great. The body would appear largest when the transit occurred in the zenith, and it would look very small when the transit took place far from the zenith. The duration of the transit could not exceed a quarter of a minute. In the drawing an observer at A would see the suspected satellite M at its best; to an observer at B it would be only about one-fourth as bright and would be on the horizon. It is at first quarter at F and is rising to A. To move from F to M requires only 25 minutes. Most of its visible path would be in twilight or low in the sky.

J. D. BLAGDEN,
Memphis, Tenn.

(*Professor Donald H. Menzel, commenting on the above letter, advises:*

"The majority of the remarks of Mr. Blagden are true. He has shown himself as possessing considerable insight into the problem. They are, however, only supplementary to the main conclusions of the original article and in no way invalidate the important fact that no moon of the size reported exists. It is true that the moon would enter eclipse when at an angle of 142 degrees with the sun and 25 minutes after first quarter. Its approximate shape at that time would be (the unilluminated portion on the left. It would be about two-thirds its maximum brightness at this time.

"Owing to the uncertainty in the reflecting power of its surface, it is impossible to compute its exact brightness. To satisfy all unbelievers we will assume the minimum physically possible—that of grayish black rock. The calculations show that this moon, just before entering eclipse, would be brighter than a first magnitude star, and would be a conspicuous object even in the twilight regions and in spite of its rapid motion.

"If it revolved in the plane of the ecliptic it would transit the sun every three hours. For a zenith transit, when it would be the largest, it would have a diameter twice that of the planet Mercury when it crosses the sun's disk. For the farthest transit it would be but little smaller than Mercury—and a conspicuous object. If the orbit is even considerably inclined to the plane in which all the planets revolve, transits would still be numerous and the object could not have been missed. It certainly would be an extremely bright object at the times of eclipses of the sun and would not have escaped detection by photography had we been blind to the foregoing proofs of its non existence."

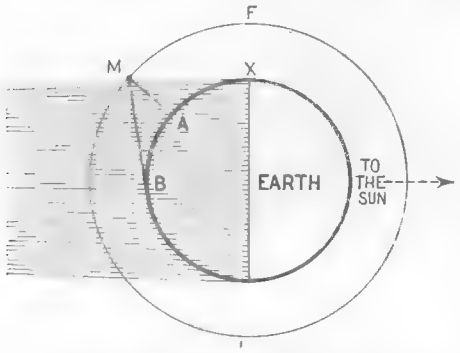

Diagram accompanying discussion on "Has the Earth Two Moons?"

So this is why it is more than probable that the earth does not have two moons.—EDITOR.)

FROZEN FISH

Editor, SCIENCE AND INVENTION:

As I read your magazine from cover to cover (including advertisements), I could not help but read the article on your experiments on freezing fish alive. I am forced for once to disagree with your conclusions, as I have frozen fish not once or twice but many times. The names and places I shall quote are correct so that if you wish to verify the following statements, you are entirely at liberty to do so.

I spent some months, on my return from overseas, in 1918, in the Squammish Valley, B. C., fishing and resting for my health. I lived at Brackendale, in that valley in a little log cabin I preempted, or to be correct, annexed. From my cabin door there was a two and a half mile trail leading to Lake Alice in the mountains, where I frequently fished for trout. During that winter, as is usual, the lake froze solid and was covered with snow about four inches deep. A friend, nicknamed Red, (name Redfern), went with me fishing through the ice. The trout, lake trout from twelve to twenty inches in length, as we caught them, were thrown into the snow where we stood. When we returned to Brackendale (we left at 10:00 in the morning and got home about 4:30), not a few of these trout were too stiff to eat. I put half a dozen in a pan of cold water while I lit the stove, and was puttering about the cabin, when I was disturbed by a prodigous splashing. I ran over, and two of the previously stiff trout were trying to climb out of the pan and get back to the lake. Much surprised (never before having seen the dead return to life), I shooed away the cat and placed them in a bucket of water. The next day I took them, most decidedly alive. over to the younger members of the family of a farmer, who was also the stage driver and a friend of mine, Harry Judd, by name. From then on, if I did not bring them from two to six trout alive, everytime I went fishing, my name was Mud. To make sure I got live trout. I used to make a little mound of snow, put the first few in the middle of it, throw my coat on top and sit on the whole while fishing, and it never failed to produce results. Some of these trout died very quickly. but others lived for several days. The species were Lake Cut-Throat Trout and small Dolly Varden Trout. The temperature at the time could not have been much less than 220 Fahrenheit, as it was not too cold to fish, and the process of freezing or whatever the comatose condition was, could not have consumed more than from ten to twenty minutes. Of these details I am fairly certain.

Previously, I never seriously considered the matter in a scientific light, so that I am unable to state what percentage suspended animation and what percentage died. Whether the coldness of the water, (it is a very deep lake) or the species of the fish had anything to do with it, I do not know, but I can assure you that what I have stated is positively and absolutely true, and furthermore, I hope some day to have money enough to go down there and repeat the performance, not for my health next time, but for fun.

I am sorry that I was not sufficiently scientifically inclined in those days to collect more data on the subject, but probably some one who has the opportunity can duplicate this somewhere sometime and get the data for you.

CECIL KAPPEY,
Calgary, Alta., Canada.

(Comments below.—*Editor*)

MORE FROZEN FISH

Editor, SCIENCE AND INVENTION:

I read an article by Hugo Gernsback in your SCIENCE & INVENTION magazine for September, relating to the preservation of life in ice. Several tests were devised which were to determine whether an animal frozen in ice would come back to life. It seems as if the tests were unsuccessful. The following is an experience I had several years ago.

A boy friend and I were taking biology that particular year at school, and we were very much interested in the subject. Naturally we spent a great deal of our time in the woods. We went out one evening to catch some Crayfish to preserve in alcohol. We brought them home and put them in a jar of water, and set them on a shelf in our laboratory. We went away and forgot about them, and as this was late in the fall the nights were cold. We even forgot to feed them. On the fourth night after we caught them it snowed, and the temperature in my home went lower than ever before. It was twenty degrees below zero Fahrenheit the next morning. I went out to look at my chemical reagents, as I was also interested in this subject. When I stepped into my laboratory the majority of my bottles were broken. The jar of water in which the Crayfish were was also frozen, and the ice pressure had broken the jar, and the three Crayfish were frozen solid in the ice. I hated myself for forgetting about them because it seemed cruel to me. It was cold all that day and the next, but the day after that the temperature rose. My friend was at my house that day and we decided that we would thaw out our Crayfish and pickle them. We went about cleaning up our laboratory, while the Crayfish thawed. We had placed them outside of our laboratory door, and when we came out our Crayfish were crawling on the ground, and we thought we had made a discovery but said nothing about it. They were two days without food and for two days frozen solid in ice.

HAVEN F. ALLEN,
Hill Top, W. Va.

(*In these cases there was no proof that the fish were thoroughly frozen. Our own experiments did not produce such results as described in the two letters above. It may have been due to the fact that attempts were made during the summer months when the habitat of the fishes was warmer waters. We intend to try these experiments again during the winter months, and would like to hear from other readers who have noted similar results, as those described in the above two letters.*—EDITOR.)

THE LIVING DEATH

Editor, SCIENCE AND INVENTION:

I have been buying your magazine for over a year, and I think that it is the best magazine that can be bought anywhere. Every time I purchase it I cannot put it away until I have read it. The articles in it are written so that they can be easily understood.

The story of "The Living Death," by Mr. Leahy, was so gripping that I could hardly wait for the next issue. I think that it would be fine if Mr. Leahy would write a sequel to this story, telling the story Zandara would tell when she learned to speak English. It would also be nice if, in this same story, Mr. Leahy would tell the story of another expedition of the same characters to the "Gardens of Paradise," and depict scenes that would clear up the mysteries left in the first story. Was there a real scientific basis for this story, and will the story be published in book form? If so, when?

GEORGE SOUTH,
Hamilton, Ohio.

(*We are glad that our scientific fiction interests you. All the facts mentioned in Mr. Leahy's story, "The Living Death," are taken from scientific works. The story itself is, of course, fictional in nature, but it is built up around findings discovered by various explorers and quotations from the writings of those explorers were frequently used in the story, which makes the theme considerably more vivid and realistic. The story has not yet been published in book form, but we do not doubt that it will find its way into bound volumes in the near future.*—EDITOR.)

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RADIO

The Advancement of Radio Telephony

By A. P. PECK, Assoc. I.R.E.

A passenger in the radio phone booth on board the S. S. Berlin communicating with a ship several hundred miles away and talking just as though he was in an ordinary telephone booth on land.

SO COMMON have the wonders of radio communication become and so tightly are they woven into our daily life that we are surprised no more, when some new feature, new apparatus or new use for radio comes to light. However, there occasionally is brought forth a system of radio communication or a process for the same that is so good that it is worthy of particular mention.

Today we have as a very common part of our life, one way radio communication or broadcasting as it is called. We have our private radio receiving sets and we hear music, lectures and sermons delivered from central points. However, except in the case of the transmitting amateur, two-way communication is a rather unusual feature. However, a recent radio installation on board a new steamer, the *Berlin*, includes a very complete radiophone transmitting station and as similar apparatus is placed on other ships, passengers will be able to converse with each other, even though they may be hundreds of miles apart, and this with as much ease as if they were using their own private telephone in their own homes. Booths as shown in the upper left-hand corner of this page are provided for the convenience of the users of this service and the photo in the upper right-hand corner shows a part of the transmitting apparatus and the operator in charge.

Not only are ships equipped for two-way radiophone communication, but land stations are under construction and being tested by means of which it may soon be possible to talk directly to foreign lands. This will be accomplished through the medium of high-powered stations operating in much the same way as our ordinary telephone exchange works. It is quite possible that you will soon be able to pick up your telephone, have the operator connect you with a central radio station and then talk to some friend or relative across the ocean, with as much ease as if they were in the same town and only the telephone line was being used. All of this may come to pass within the next few years, as much development work is now being done along this line. Photos below show type of equipment that may make this work possible. Experiments are being carried on with short and long wave-lengths.

The Chief Radio Officer of the Berlin in the radio room showing part of the radiophone apparatus used for intercommunication between ships.

The photograph directly above shows a part of the antenna installation and the buildings housing the radio apparatus at Rocky Point, L. I. It is said that this station may soon be employed for direct radiophone communication with London.

This photograph shows a portion of the stupendous installation of equipment used at the Rocky Point, L. I., station. When it becomes possible to carry on a radiophone communication with foreign countries, it is said that the charge for a 3-minute conversation to London will not exceed $5.

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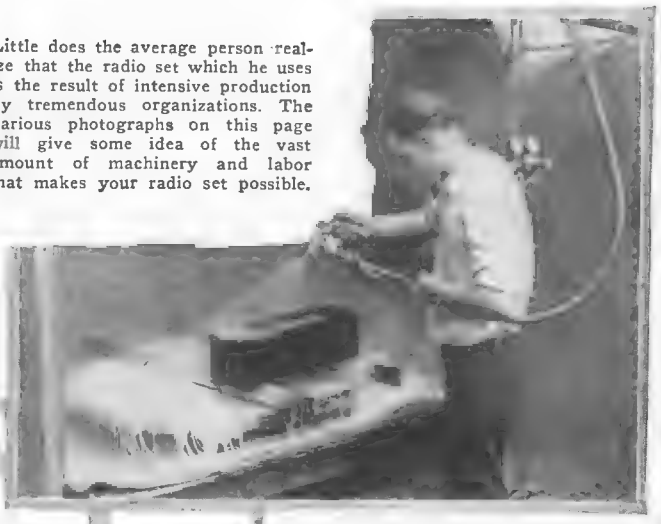
Radio Sets by the Thousand

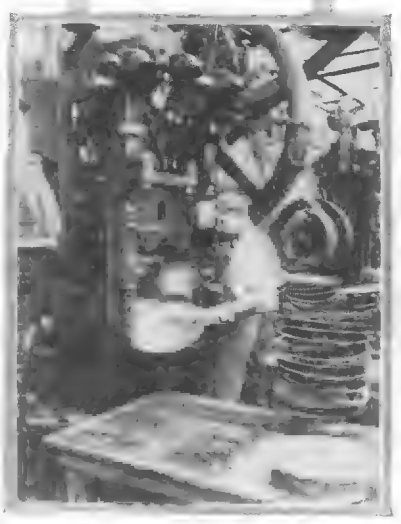
Little does the average person realize that the radio set which he uses is the result of intensive production by tremendous organizations. The various photographs on this page will give some idea of the vast amount of machinery and labor that makes your radio set possible.

Above: A general view of a radio manufacturer's testing laboratory. Here the sets are put through their various paces and if they do not prove satisfactory they are rejected. Thus good results are assured.



Finishing radio set cabinets with an air brush spray of high grade varnish.

A close-up view of one of the assembling tables in a large radio manufacturing plant. The young lady is engaged wiring an almost completed radio receiving set.



Here we see one of the presses used for making stamped metal forms. This particular one turns out the bell parts of radio loud speakers. Quantity production of this nature is what brings down the ultimate cost of quality apparatus. Note the finished bell being removed from the machine.

Would you ever think that your dials that control your radio receiving set came from a machine like the one in the above photograph? They do, as this is one of the hot stamping machines that press bakelite or other insulating material into the form of dials. The operator is holding one of the dies in his hand, being protected from the heat by a heavy glove.

A general view of one of the gigantic assembling rooms of a radio set factory is shown directly above. All of the employees are busily engaged in assembling various parts of sets.

Here is another view of one of the assembling rooms. Note that each one of the workers has a certain part assigned upon which each works to the exclusion of all else.

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How to Follow WRNY

By DR. CHARLES D. ISAACSON

Further notes are given below on the novel plan being carried out by the program director of Station WRNY.

NO MATTER where you are you can pick up WRNY and work right into its developments any day, any hour. Of course you can look into the daily newspapers and find what is happening if there are last-minute changes, but for the whole general plan all you need do is to look into WRNY's big prospectus of the general broadcast program and special features, and it is the easiest thing in the world.

In the center of the book is an outline of any two weeks, just where any feature appears in a two-week plan. Thus, let us say it is Tuesday, you locate Tuesday, say 8 o'clock, and you find that the Hampson Light Opera Company is giving, let us say, "The Tales of Hoffman." You know you are then in week one, and from that moment forth you can follow WRNY that week into the second week and back again into the first week, just like a great big race track that is a circle—if you start at one point, you go around and come back to it. Or, if instead of the Gordon Hampson Light Opera Company, the Mme. Andres Parker Singers are appearing at that time you will know that you are in the second week of the WRNY standard schedule and you will begin there and follow the rest of the week and back into the first. Thus you can pick up WRNY at any time and move in unison and understanding with the program department and all of the staff of WRNY.

USING THE WRNY PROSPECTUS

But there is something more than that which you can do. Let us return to the idea that this is Tuesday, 8 o'clock, and that the Gordon Hampson Light Opera Company is appearing. You turn to the back of your big program book to the general index and you find under the heading of the Gordon Hampson Light Opera Company reference to page 7. You will discover who is in the cast, information about the singers and the conductor and you locate where you are in the repertoire which they are singing so that you can fit immediately into that individual company's development. You know what you have missed and what you are still to hear and you are immediately *en rapport* with the whole spirit of that organization.

LENI STENGEL—The continental comedian sings songs in his own inimitable manner.

ALFRED McCANN—He is unquestionably the world's foremost authority on food. Alfred McCann at WRNY.

RITA MAGINOT—Gives the series of A to Z Piano Classics and also directs "Rita's Kiddy Music Party."

PIERRE REMINGTON—One of America's finest light opera bassos. Pierre Remington is a member of the Gordon Hampson Light Opera Company.

BERNSTEIN SISTERS TRIO—Minna, Deborah and Selma, are musicians of remarkable ability.

GRACE POTTER—One of our foremost psychoanalysts, who has studied with Freud, appears at WRNY.

MAJ. ATKINSON—Here is the indomitable world traveler, Major Dent Atkinson of WRNY.

MRS. PEMBERTON—Mrs. Brock Pemberton, wife of the theatrical producer and designer of the costumes for "The Green Hat" speaks on theatre costumes.

BEN BERNIE—The maestro, as he is called, leads one of the most popular orchestras in the world.

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KATHRYN BEHNKE—This is the "Lullaby Lady," Kathryn Behnke.

RADIO ART THEATRE—A stock company devoted to the classics. In the picture are Miss Bellfato, Miss Perry, Mr. Newmark, Mr. Luden, Mr. Pratt and Miss Sonergaard.

HARVEY WILEY CORBETT—The architect of the new National Masonic Memorial to Washington is the director of architecture at WRNY.

NICHOLAS ORLANDO — He leads the Roosevelt Concert Orchestra three times a week at WRNY.

ROSE DREEBEN — The poet-peasant, sings the songs of the people in all their native simplicity.

JOHN MARTIN—The most beloved friend of children, directs WRNY's fairy tale period.

CUGAT—The Spanish violinist, Xavier Cugat, besides being one of our best violinists, is a capable and gifted cartoonist.

Now let us suppose that you are particularly fond of light opera and you want to know whenever light opera companies appear. You refer again to the general index at the back of the book and find that heading which gives you all of the individual companies and singers interested in light opera. You turn all these pages and find out how much light opera is going to be given you in the course of six months. For this new book, which is 64 pages, the size of a magazine, gives you the whole program of WRNY for a complete six months' period.

It gives you pictures of all of your favorite people, it provides you with the story of their careers and the plan of their offering to you at WRNY. It is extremely interesting and valuable and many hundreds will be constantly referring to this book, which will be as fixed an attachment to their radio receiving sets as the dials. It is a compendium of information, a complete curriculum of what you are going to hear. This new book and this new plan of WRNY takes away all of the haphazardness and vagueness of original broadcast program making. It means that WRNY is promising a definite policy, that, allied with WRNY, is a fixed system and that everything which happens at WRNY is moving along a definite channel of thought.

The book is being distributed now and I suppose it will not be long before several thousands of people will be asking for copies, after we have run out of the first edition and have to reprint. Radio News has been very generous and has agreed to send this volume out to you absolutely without charge.

This book and all that is happening here at WRNY is opening a great new field for radio. It does not seem to me possible, as some have suggested, that with the broadcasting of grand opera in the sort of manner that we bring it, in little tastes, people are no longer going to the opera—quite the reverse. I believe that *because* we are giving the stories of the opera, the principal melodies of the opera, that you, the listener, will find it necessary to go to the real performance. I am frank when I say to you that no radio performance could satisfy me, no matter how fine the artists, the performance, the radio set. I want to see the theatre itself, the stage, the setting, the actual living performance. There is, on the other hand, the individual who listens to the broadcasting of a game, baseball, football. That could never satisfy or be a substitute for the actual game itself.

For myself and for WRNY, I repeat again and again that we want to make more people go to theatre, attend the opera and concerts, witness games, read books, view art exhibits, hear lectures and live with the actuality. Broadcasting anything is merely an impetus to the real thing, if it is worth while.

So this new book and new plan of WRNY enables the listener to pick any field of human endeavor in entertainment and education and acquire enough knowledge and taste for any individual feature to want that feature in actuality.

Here one can find the entrance into some unknown field. Let us take architecture. Who is interested in architecture besides the architect? Very few, and yet all about us are great buildings. They belong to us as much as to those who own them. Here is Harvey Wiley Corbett, one of the world's greatest architects, to tell us about architecture. Mr. Corbett speaks for five minutes a week.

WHAT THE MONTH HAS BROUGHT

I remember that Helen Meany, champion diver, came over; that Resta Crowell gave us a charming presentation of "The Second Mrs. Tanqueray," and I recall the many visits to other lands which we made with J. Van Cleft Cooper and the Volga Trio.

In grand opera, the DeMacchi Opera Company gave us "Rigoletto." The Taverna Opera Company gave us "Cavalliera" and "Il Trovatore" and the Louis Aschenfelder Company "Manon" and "La Bohéme."

Then there were those gatherings on Tuesday evenings, known as "Up and Down Broadway." We had the whole cast of "No, No, Nanette," with the principals, Louise Groody and Charles Winninger; Blanche Ring and Otto Harback were also here. The

(*Continued on page* 867)

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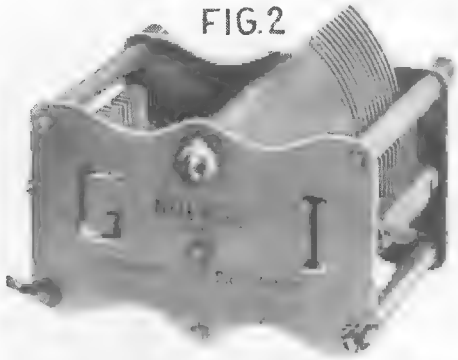
Concentric Versus Eccentric S. L. F. Condensers

By WM. M. HENDERSON

THE straight-line frequency condenser is conceded by many engineers and radio fans to be the only instrument that will facilitate the tuning of stations below 300 meters, though there is a tendency on the part of some to sponsor an attempt to solve an electrical difficulty by mechanical methods.

The insertion of a straight-line frequency condenser in a tuning circuit will make the

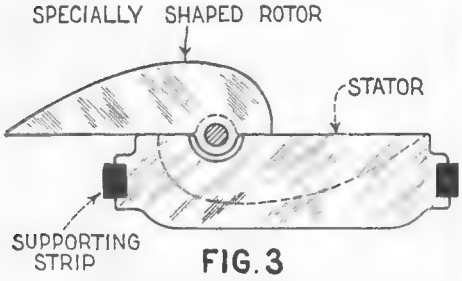


A type of concentric rotor plate S. L. F. condenser in which the stator plates are cut away so as to give the S. L. F. effect.

tuning of short wave stations as simple and easy as tuning of the long wave stations is on a straight-line capacity instrument, providing that the circuit used is inherently selective.

The actual history and experimental stages of straight-line frequency condensers has been printed many times before, but one point in the construction of these tuning accessories has never been brought out with sufficient emphasis.

This point is the construction, or rather, the shape of the plates. There are two general types of straight-line frequency condensers, one using the eccentric rotor and the other using the concentric rotor, centered type of plate. As every radio owner wishes to use the instrument that is best mechanically and electrically in his construction of



An eccentric rotor type of S. L. F. condenser using specially shaped rotor to obtain the required capacity and frequency curves.

receiving sets, a detailed description of each type will be given.

The eccentric plate type of straight-line frequency condenser is practically an outgrowth of the eccentric type of straight-line wave-length instrument. In the S.L.W. (straight-line wave-length) type the rotor plates are cut away on one side. The dimensions of the plate are such that the capacity of the condenser changes to give a straight-line wave-length characteristic. This cutting away of the rotor plate unbalances the rotor by forcing the shaft to carry more plate area and, consequently, more weight on one side than the other.

To counteract the resultant top-heaviness of the rotor either a balance weight must be used or tight bearings become a necessity. Tight bearings will naturally cause a stiff

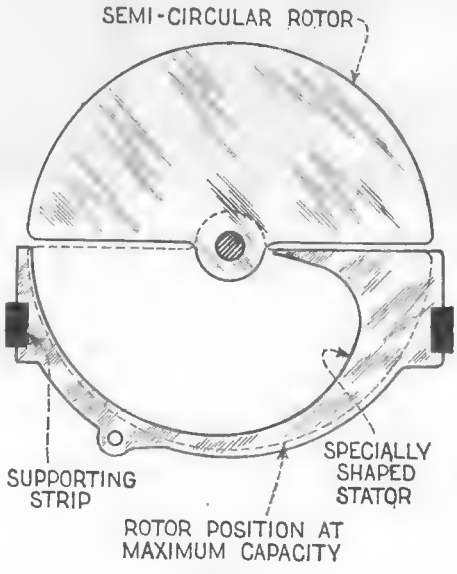
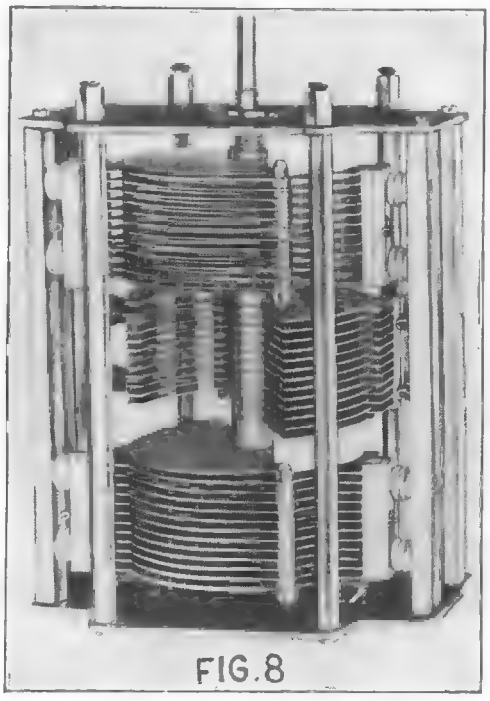


FIG. 1

Fig. 1 shows how the stator plates of a condenser similar to that shown in Fig. 2 are cut away.

and hard turning rotor and as the bearings wear, which they will, on account of the increased friction, the rotor will become loose and the heavy portion will overbalance the shaft and tend to move when the

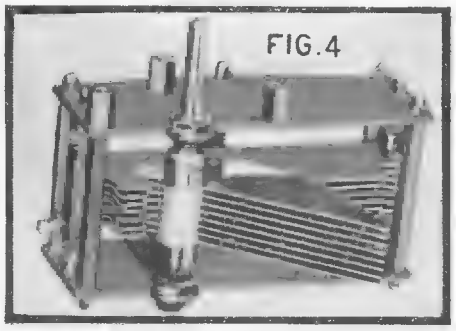


A tandem type of S. L. F. condenser using concentric rotary plates and shaped stators.

dial is released, thereby making tuning an impossibility.

In the straight-line frequency condenser, the dimensions of the plates must be such that the capacity of the instrument changes very slowly for the first 70 degrees and then at a greatly increased rate for the last 30 degrees. In other words, the S.L.F. condenser is but a greatly accentuated S.L.W. instrument.

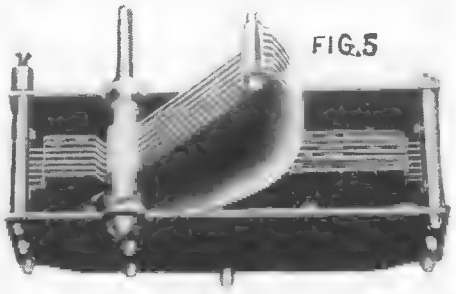
To obtain this straight-line frequency characteristic with an eccentric plate condenser the rotor shaft must be placed almost at one side instead of in the center, thereby putting practically all the weight of the rotor plates on one side of the shaft.



The photo in Fig. 4 shows an eccentric type of S. L. F. condenser, the shape of whose plates are indicated in Fig. 3.

In addition to the off-center position, the rotor plates are long and narrow in shape, as shown in the diagram in Fig. 3 and the photos in Figs. 4 and 5. The stator plates are shaped as shown.

The combination of an off-center rotor and long narrow plates results in a rotating element that is out of proportion mechanically, and so unbalanced that unless a compensating weight is used the extremely tight bearings that become essential without the balance weight wear out and frequent adjustment becomes necessary. In addition to this fault, the average eccentric plate S.L.F. condenser requires panel space almost equal to twice its length, due to the long swing of the rotor. In this type of condenser, it is almost impossible to maintain perfect rotor and stator plate alignment, due to the long



Another and still different type of S. L. F. condenser in which the rotor plates are eccentrically placed.

lever arm of rotor and flexibility of metal.

Straight-line wave-length and straight-line frequency condensers can be designed so that tight bearings, balance weights and large size are eliminated, so that the instrument will be mechanically correct, and still be electrically efficient.

To do this, the rotor plates are left semi-circular in shape, as shown in Figs. 1 and 2, and the stator plates are cut to give the desired characteristic. The stator plate shape given in Fig. 1 is for a straight-line frequency instrument. This shaping of the stator plates will, of course, incorporate no

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mechanical defects in the condenser rotor and, therefore, we can have an instrument with the same smooth operation as was obtained in one with a straight-line capacity characteristic and yet be a true S.L.F. condenser.

Thus, with one operation, an instrument is made that is mechanically efficient and, with proper choice of insulation and insulation placement, electrically efficient.

A condenser so designed is known as a concentric plate instrument, because the rotor is in the center and the plates are mounted on the shaft so that the weight is evenly distributed.

With the increasing popularity of single-control tuning, the double and triple condenser is going to become quite a factor in receiving set construction during this year, and probably much more so next year.

To make double and triple units using eccentric plate straight-line frequency condensers would result either in a greater mechanical failure than in a single unit, or in as great a mechanical failure and, in addition, there would be a very bulky instrument.

The concentric plate type of S.L.F. condenser lends itself admirably to double and triple unit construction, and no mechanical or electrical errors need be made. A photograph of a triple condenser made up of three concentric plate straight-line frequency condensers is given in Fig. 8, which will show the general lines of good mechanical and electrical construction.

In tuning with straight-line frequency condensers, it is obvious that the capacity variation will not be uniform. The exact way in which this variation takes place is shown in Fig. 6. However, with a properly designed inductance, the tuning curve of such an instrument will be practically straight when dial settings are charted against frequency. Such a curve for a standard arrangement of an inductance and a straight-line frequency condenser is given in Fig. 7. Note how the short wave stations are separated to a greater degree than obtains with straight-line capacity condensers and how the longer wave stations are closer together. With a properly designed receiver, this makes a nearly perfect balance of tuning. Thus the results are nearly all that can be desired.

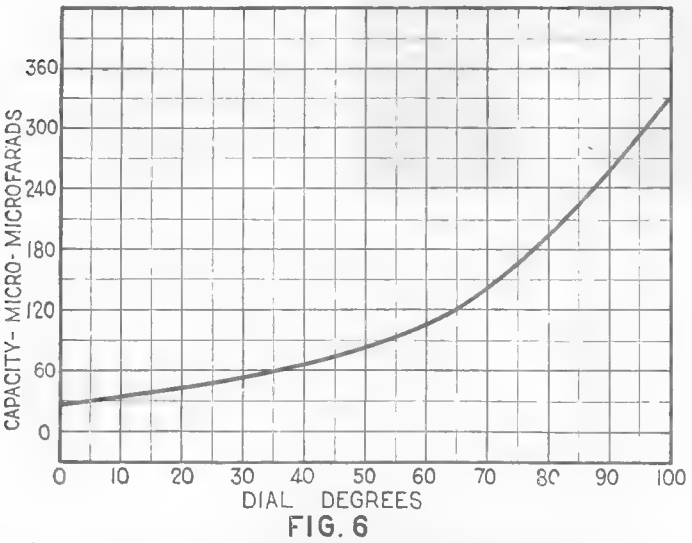

FIG. 6

The curve Fig. 6 shows how the capacity increases as the dial controlling the straight line frequency condenser is rotated. Note the gradual increase at first and then the rapid increase above 70° on the dial.

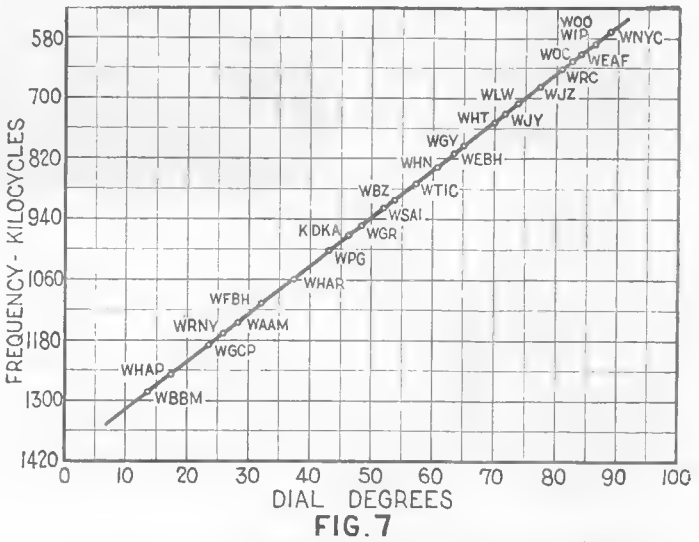

FIG. 7

Fig. 7 shows how the increase in frequency plotted against dial degrees gives a straight line, and also shows how the various stations are separated. This curve was made under actual working conditions and is accurate.

Grid Leaks—The Biggest Little Things in Radio

By FRANCIS R. EHLE*

FOR a great many years after the introduction of the three element vacuum tube to the radio art, the use of an extremely high resistance in series with the grid of the tube was mostly a matter of hit or miss. Wireless operators, who at heart are all experimenters, found that a pencil line or a smear of ink connecting the terminals of the grid condenser, made a very considerable difference in the sensitivity of their receiving set. Eventually manufacturers of wireless equipment incorporated a crude high resistance to accomplish this result.

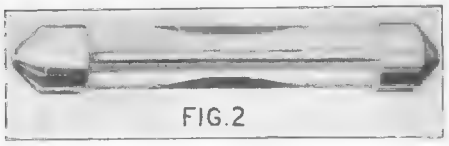

FIG. 2

A grid leak with metallized resistance element which is accurately made.

Since the advent of radio for the dissemination of entertainment to millions, the grid leak has come into more and more respect and it is now considered verily "The biggest little thing in radio." Changes in tube construction, as regards the various voltages used for their operation, different types of filaments, a multiplicity of circuits, all mean a different value of grid leak for most efficient operation.

When the specifications call for a "one meg" or "two meg" grid leak, they mean that one million or two million ohms of resistance are required to enable the accumulated charge of the incoming signal to leak off the grid of the tubes in time for the grid to be free for the succeeding electric charge.

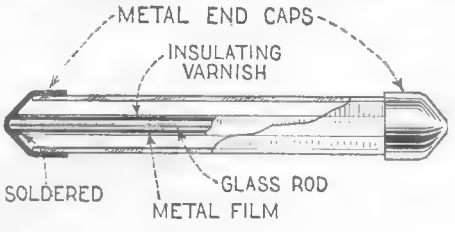

FIG. 1

Cross-section of a grid leak unit using a metallized resistance, showing construction.

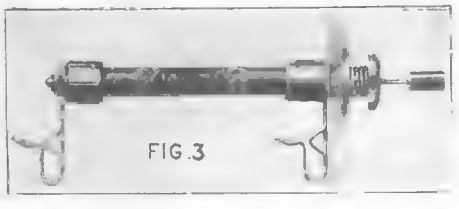

FIG. 3

A standard type of variable grid leak adapted to panel mounting.

A simple analogy may be made of the carburetor of an automobile. The motor is the detector tube of the receiver, the carburetor the grid leak. If the carburetor is fed too much gasoline, the motor is choked and, as a result stops, and by the same token if the grid leak allows too much of a charge to remain on the grid of the tube, it chokes or as we say paralyzes. If the carburetor is fed too little gasoline, decreased power results in the motor and our analogy to the grid leak is still correct as when the grid leak is of too low a value decreased sensitivity results in the receiver.

The grid leak may be considered as a valve controlling the amount of electrical energy that the detector tube can efficiently take care of without overload.

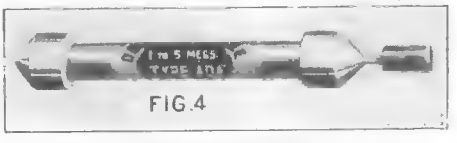

FIG. 4

Another type of variable grid leak to be mounted in a standard clip holder.

Any loose connection or minute electrical defect in the grid circuit is more apt to cause noisy crackling reception than in any other portion of the receiving circuit, because in the detector tube the actual transforming of energy from the ether to audible sound takes place, to be amplified many times in the audio frequency portion of the set. Thus any imperfection in the grid leak, because it is in the grid circuit of the detector tube, is certain to make itself well heard in the loud speaker.

(*Continued on page* 869)

*Vice-President of Durham & Company, Inc.

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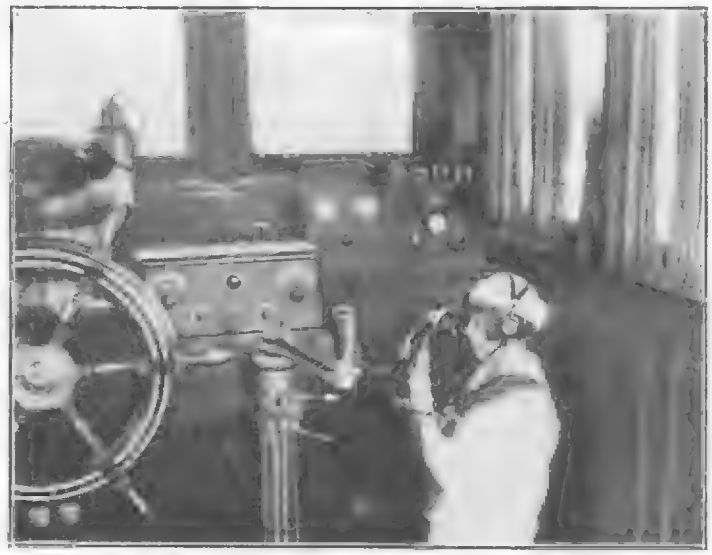
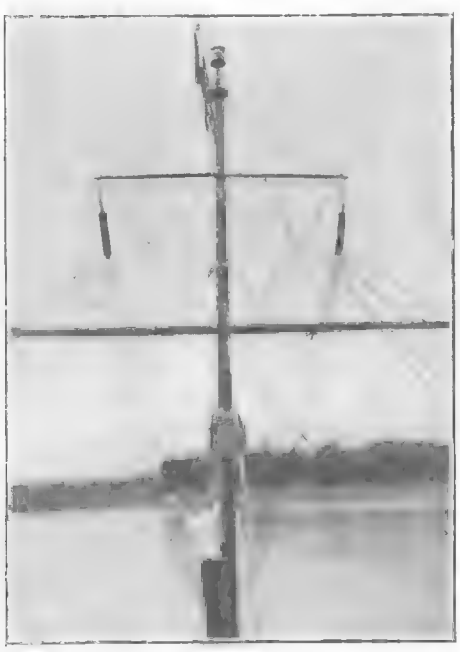
Broadcasting Station on Yacht

THE growth of radio has been so great in the past few years that we are not surprised at any time to see a complete broadcasting station in a most unusual situation. Such is the case with the station that is illustrated on this page. Owned by Powel Crosley, Jr., of Cincinnati, Ohio, this installation provides the owner with many hours of interesting experimental work. Inasmuch as the station can be used under totally different conditions merely by traveling to a distant point, results can be observed that would not be found with a permanently fixed location. The station operates on low power, but has a comparatively long range.

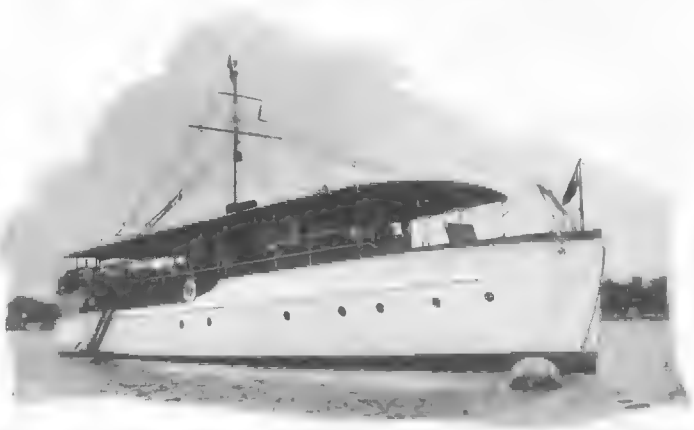


THE photo at the left shows the daughter of the owner of this floating broadcast station operating the transmitter and conversing with a shore station. The transmitter is located in the pilot house of the yacht and can be seen above and to the right of the receiver. The latter is located directly in back of the control arm. With this outfit, conversation is often carried on with other vessels, the replies usually being in code. The results obtained are all the more remarkable, not only because of the low power used, but because of the peculiar conditions under which the set is operated. Unusual and interesting results have been attained.

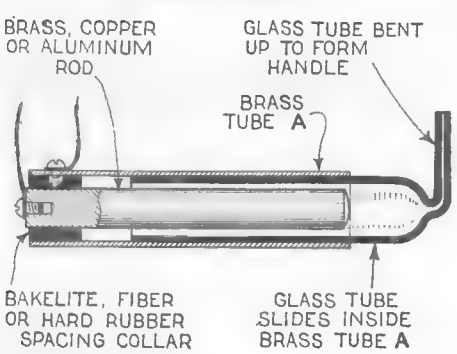


A close-up of the center suspension of the unique aerial used on board this yacht is shown in the photograph at the left. Note that four small cage aerials are used. The cages that are placed end to end are connected in series so as to give the effect of a straight cage. Even though the aerial wires are quite low as compared to the usual broadcasting aerial, the results obtained show that the installation is quite efficient.

The yacht *Muroma,* upon which this portable broadcasting station is located, is shown in the photograph directly below. Note how the aerials are hung from the only mast and are supported at opposite ends of the craft. This installation had to be especially designed for the particular use to which it is put and much experimental work had to be done before the best of results could be obtained.



Condenser


BRASS, COPPER OR ALUMINUM ROD
GLASS TUBE BENT UP TO FORM HANDLE
BRASS TUBE A
BAKELITE, FIBER OR HARD RUBBER SPACING COLLAR
GLASS TUBE SLIDES INSIDE BRASS TUBE A

A simple variable condenser that will find many uses around the experimenter's workshop may be made as shown above. No dimensions are given as they may be varied to suit the material on hand. The center electrode acts as one plate of the condenser and the external tube as the other. Varying the position of the glass tube changes the effective capacity of this compact variable condenser.

—G. H. Waetjen.

Radio in Business

AND now the business man can have his radio set with him all during the day. One ingenious fan has built the set into one of the drawers of his desk in such a way that the drawer can be closed and the radio set completely covered and placed out of sight. Another drawer can contain the batteries while the loud speaker is placed on the top of the desk. Various news items and market reports of interest to the busy executive can be received immediately without any loss of time. A set of this nature is simple to make.

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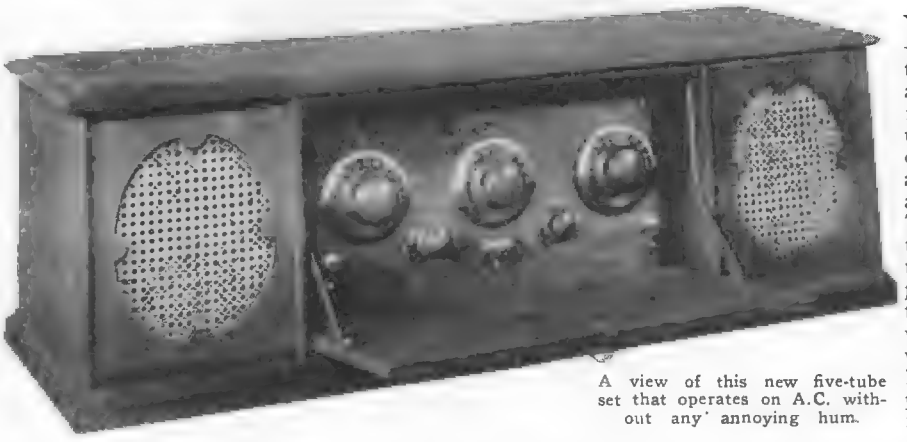
Five-Tube Set on A.C. or D.C.

Power Unit Supplies Both "A" and "B" Potentials from 110 Volts A.C. or D.C.

THE photograph at the right shows the external appearance of this new radio receiving set. Note the pleasing balance of sections that is obtained by placing the two grills on either side of the radio receiving-set panel. One of these grills covers the mouth of an efficient loud speaker, while the other is a dummy and merely serves to preserve balance. In back of it is the power supply unit, which supplies the filaments and plates of the tubes from A.C. or D.C.



A view of this new five-tube set that operates on A.C. without any annoying hum.

NOT only is this new radio set self-contained, if we except the aerial and ground, but it furnishes its own table upon which log sheets and other data can be placed and which also serves as an arm rest for tuning. This table folds up against the face of the set so as to protect the dials and panel from dust and so as to hide the set from sight when it is not in use. The view at the left shows this leaf in operating position, practically representing a flat-top folding desk.

SO much interest has been manifested of late in battery eliminators of all kinds that we are presenting herewith an illustrated description of a radio receiving set which is not only selective and stable in operation, but which also incorporates an "A" and "B" battery eliminator in the same cabinet.

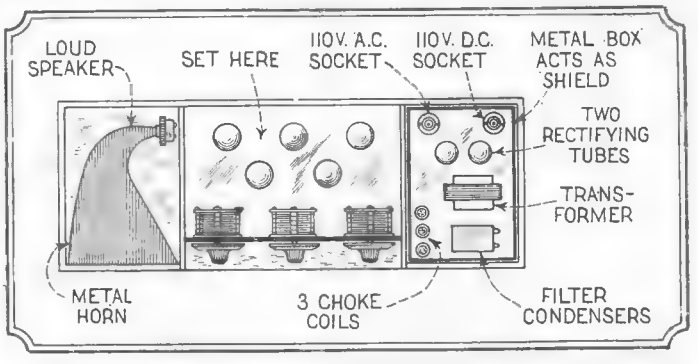
It has often been said that a battery eliminator of any type, when used in connection with a radio receiving set, should be placed at quite a distance from the set proper. This is because of the fact that the magnetic field of the transformer may interact with some part of the radio set, and cause a loud hum to be heard when in operation. This, however, has been overcome by the manufacturers of this particular unit by the simple expedient of placing all of the eliminator apparatus in a metallic box. This acts as a shield and prevents the field of the transformer from affecting other instruments. By doing this it is entirely possible and practical to incorporate the unit in the same cabinet with the set as can be seen in the right-hand illustration in the center of this page.

The construction of the battery eliminator itself is quite unique. Two rectifying tubes are employed so that both halves of the A.C. wave can be rectified and utilized. Before the current enters these tubes, it goes through the transformer. The choke coils and filter condensers serve to smooth out the rectified current, which in itself is not pure enough to be used on the radio set. This smoothing action produces practically pure D.C., which when applied to the plates of the tubes does not produce any objectionable hum when the set is used with two stages of audio frequency amplification and the received signals are reproduced in the loud speaker, as demonstration proved.

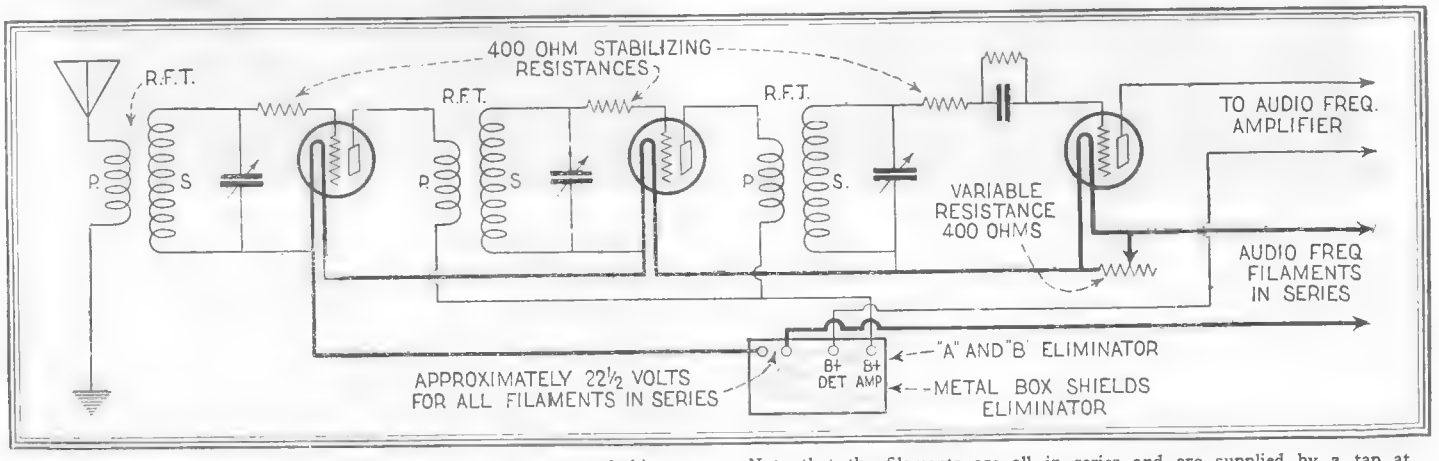
Note that the filaments of all of the tubes are connected in series. By doing this, smaller wire can be used on the filament secondary winding of the transformer as that winding has to carry only slightly more than one-quarter of an ampere. In order to aid still further in reducing the hum and to obtain quite critical control over the detector tube, a 400-ohm resistance is shunted across the filament of the detector. This resistance is variable and the position of the arm is to be changed until the best results are obtained.

Since this set employs two stages of radio frequency amplification, it is necessary to provide some sort of stabilization in the circuits of the first three tubes. This is done by means of three 400-ohm stabilizing resistances inserted in the grid circuits of the first three tubes as shown in the diagram below. Thus oscillation is prevented and squealing eliminated.

The photograph directly above indicates the appearance of this set when the leaf is folded up and the receiver is not in actual use.



The general view above shows the placement of the various parts of this novel set. The battery eliminator rectifies both halves of the cycle.



The circuit diagram of the radio frequency and detector parts of this set is shown above. The audio frequency amplifier is of standard construction.

Note that the filaments are all in series and are supplied by a tap at approximately 22¾ volts on the battery eliminator unit.

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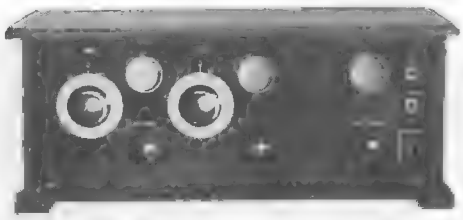
Three Tubes Do the Work of Four

By SIDNEY E. FINKELSTEIN, Assoc., I. R. E.

PROBABLY the most interesting of all radio receiving sets, both from the experimenter's and the broadcast listener's standpoint is the reflex circuit. Not only can a saving in tubes be effected, but some exceptional and frequently astounding results are often obtained. The saving feature in itself is a great one from two viewpoints. First, the initial cost of the entire set is reduced when the reflex principle is employed, because of the fact that fewer tubes and sockets need be purchased. Then too, the upkeep is reduced because, considering the particular set under discussion, only three tubes are employed, they give the results of four but still they only consume as much filament current as three. This in itself is a big feature, inasmuch as your "A" battery will last much longer with this three-tube reflex circuit than with a standard four-tube set.

A year or two ago the building of a reflex circuit was a hazardous proposition inasmuch as one contemplating this work had to purchase the various instruments on the open market and was not sure that the different transformers would work together correctly. Today much of this trouble can be eliminated because of the fact that various manufacturers of radio instruments have realized the need for matched parts that will give good results in reflex circuits and, therefore, have put on the market, kits of instruments which when hooked up correctly, will give the very best results with the least trouble.

The set illustrated in the photographs on this page was made from standard parts put up in kit form. The results obtained with it were surprising. "DX" stations could be tuned in with little or no trouble and could be reproduced with the loud speaker. Local stations came in with wonderful volume and in some cases it was even necessary to cut down on the filaments or to detune slightly, inasmuch as the volume delivered was too great for the loud speaker to handle when the set was operating on its greatest efficiency and directly on the wave-length of the transmitting station.



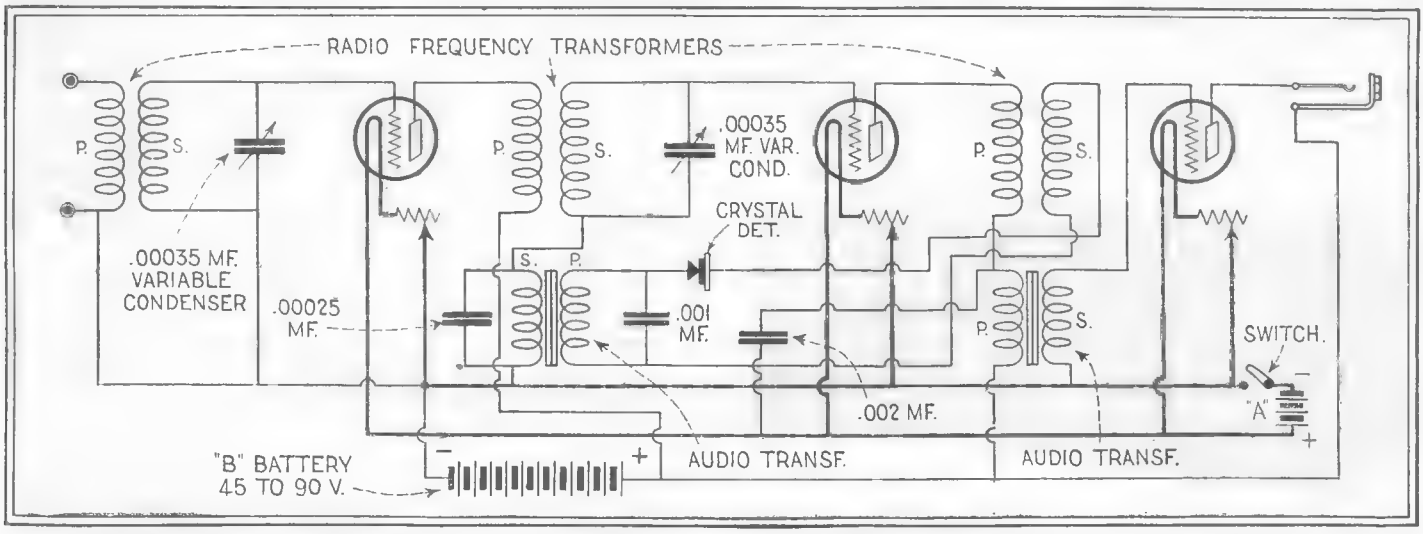
A front view of this neatly designed and compactly constructed three-tube reflex set embodying two stages of radio frequency and two stages of audio frequency amplification.

Reference to the circuit diagram given shows that the three tubes constitute two stages of radio frequency and two of audio frequency amplification. A crystal detector is used as the rectifier rather than a vacuum tube, because of the fact that if a good fixed crystal detector is employed, controls are eliminated and the results are very good. The set is quieter in operation and the reproduction is clearer inasmuch as the distortion, slight though it may be, that is often found in vacuum tube detectors, is eliminated.

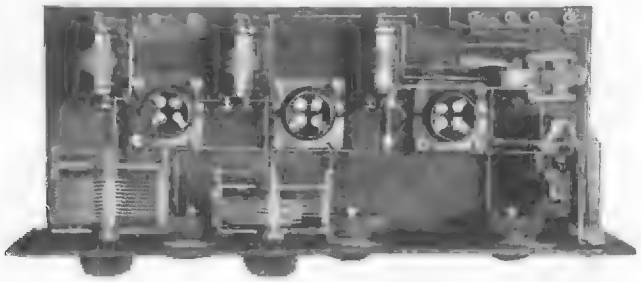
If the reader intends to build a set of this nature and uses parts similar to those shown, they should be arranged on the baseboard in much the same manner as can be seen in the various photographs. Be sure to mount the audio frequency amplifying transformers so that their cores are at right-angles to each other, and also place the radio frequency amplifying transformers a few inches apart. This can be accomplished by placing them as shown.

A novel method of mounting the crystal detector is indicated. Two pieces of bus bar, such as that used in wiring the set, are bent up at the ends and loops are formed so that the ends of the cartridge type crystal detector can be clamped in them. In this way, connections are eliminated and the necessity of using a special mounting for the crystal detector is done away with. Note how the fixed condensers are mounted directly on the audio frequency amplifying transformers. Here again, one or two short leads are eliminated with an increase in efficiency.

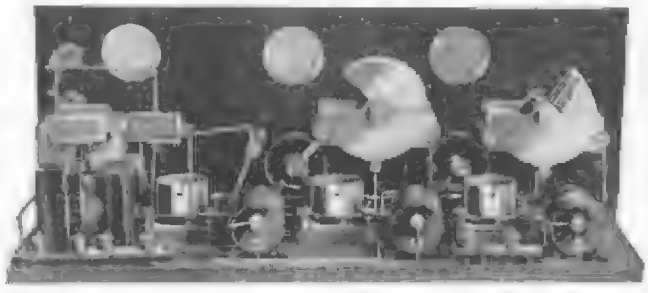
Inasmuch as the third tube is used only as an audio frequency amplifier, another jack can be placed in the circuit shown here by connecting the two inside springs to the primary of the audio frequency amplifying transformer and connecting the two outside springs to the wires which in the diagram are connected to the transformer. In this way, by placing a plug in the jack so connected, only one stage of audio frequency amplification will be used. This is useful for tuning in "DX" stations or for listening in when it is not desired to operate the loud speaker and disturb other members of the family with the volume.



The circuit diagram shown above gives all the connections necessary for hooking up this highly efficient, tube-saving circuit. Only one jack is shown in the diagram and if another is desired, it can be connected as described in the text. Use a good fixed crystal detector.



The top view, shown above, indicates the placement of practically all of the apparatus necessary for making up a set of this nature.



The rear view shows more of the details. Note the position of the fixed condensers on the audio frequency amplifying transformer.

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An All-round Broadcast Receiver

Describing a Set That Is Simple to Operate, Yet Selective and Stable

By A. DOLID

REGARDLESS of the fact that the past two or three years of intensive radio development have brought out hundreds of so-called new and unusual circuits, still there are certain types that when properly built and operated have withstood the test of time, and are with us today in practically the same form that they assumed when first presented to the radio public. Probably the best example of this type of receiving set is that shown here and known as the Reinartz receiver, in which certain connections are used that have remained practically unchanged.

Although no exceptional features are incorporated in this article, still the results that can be obtained with the set are so good that we feel that the details given will be welcomed. If you have a set of this type in your experimental laboratory, you can turn to it at any time you desire, when you are tired of using "funny" sets that give "funny" results, and be sure that the old reliable standby will enable you to do almost anything that can be expected of a three-tube receiving set.

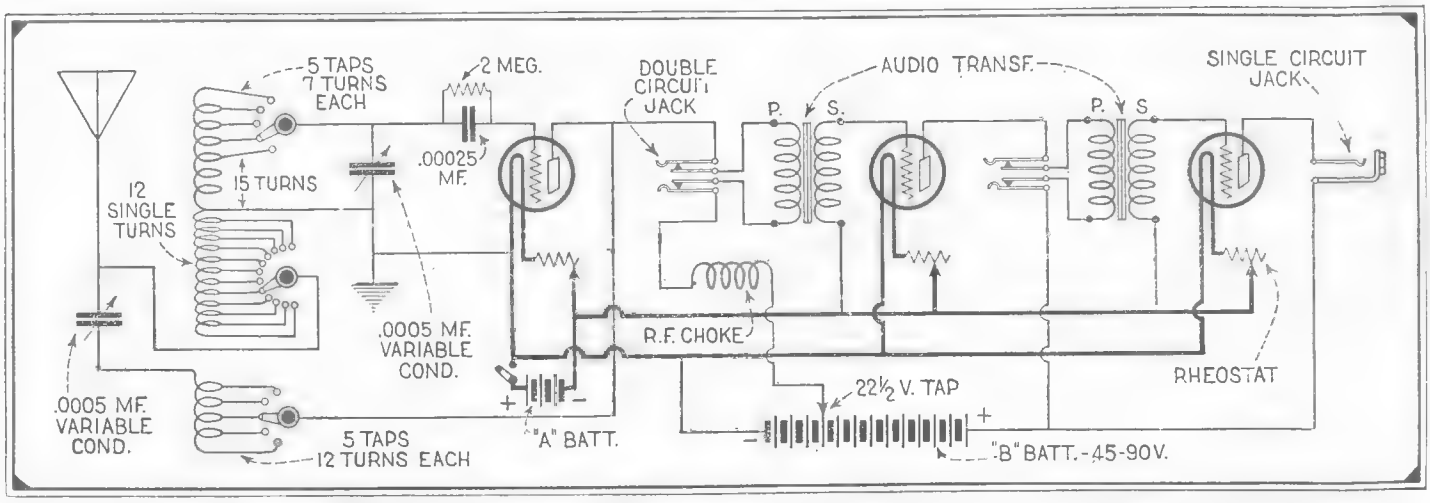
Here we see a rear view of this well made three-tube Reinartz receiver. The detector tube and the audio frequency amplifier are mounted on a small sub-panel.

As can be seen in the photograph in the upper right-hand corner of this page, the two inductances used are wound on the same form, which is nothing more or less than an ordinary spider-web form 4 inches in diameter and with the usual odd number of slots. Thirteen, fifteen or seventeen slots will be perfectly OK. No special number are necessary. The coil is wound in the usual over one and under one leg of the form, or a variation of this method can be used, and the turns can be wound under one and over two. Either type of winding will be found satisfactory. As shown in the diagram in the center of this page, two coils are used and one of these is divided into two parts. When making up your coil, wind the plate coil on the form nearest the center. Wind 60 turns of wire, connecting the inner end of the winding to the first switch-point on one of the five point switches. Then take off a tap every 12 turns, connecting the four taps so formed to the remaining four switch-points. Connect the remaining end of the winding to the stator plates of one of the .0005 mf. variable condensers.

Then, starting a new coil, wind 12 turns of wire, making a tap on every turn. Connect these taps to the 12 point switch as shown. Then wind 15 turns without any taps and take off a lead at the fifteenth turn. Continue with the winding, taking a tap every 7 turns until four more taps have been taken. This completes the winding of the inductance coils, which should be wired up according to the diagram. Thus we see that we have a secondary consisting of a total of 50 turns of wire tuned by a .0005 mf. variable condenser. The 12-turn section constitutes the antenna coil and the 60-turn winding is the feed-back or regeneration coil.

Regeneration is to be controlled by the 5 point switch as well as by one of the .0005 mf. variable condensers. This is the least critical control, whereas the other variable condenser is just the opposite and requires the finest tuning. The rest of the set, as can be seen from the photographs and drawing, is quite conventional with the exception of the radio frequency choke. This should preferably be connected on the other side of the double circuit jack from that shown in the drawing. It may consist of a form, 1 inch in diameter by 5 inches long, wound for its total length with No. 30 S.C.C. wire. It functions to make the regeneration control smoother and more stable.

We are sure that any of our readers who construct a radio receiving set of the type outlined in this article will be more than pleased with the results that they obtain with the same. We do not claim phenomenal reception ranges or enough volume to rattle the windows in houses two blocks away, but we do claim for this receiver the same thing that a good many people claim for the lowly "flivver"; it will get you there and bring you back. The set will give you good reception under practically all conditions and if your instruments, tubes and batteries are in good shape, you will seldom if ever have trouble. And so, folks, there are the details—go to it.



The circuit diagram of this receiving set shown above indicates all of the necessary connections for hooking up the various instruments. In the case of the tuning condenser, connect the rotor plates to the ground so as to eliminate any body capacity effect. Standard parts should be used to insure the best possible results. Use a 5 to 1 ratio transformer in the first stage and a 3 to 1 ratio in the second stage.

The panel view shows the neat construction of this set. The two vernier dials control the tuning and regeneration condensers. The switches also aid in the same way. The knack of tuning this set is quickly learned, as the controls are simple.

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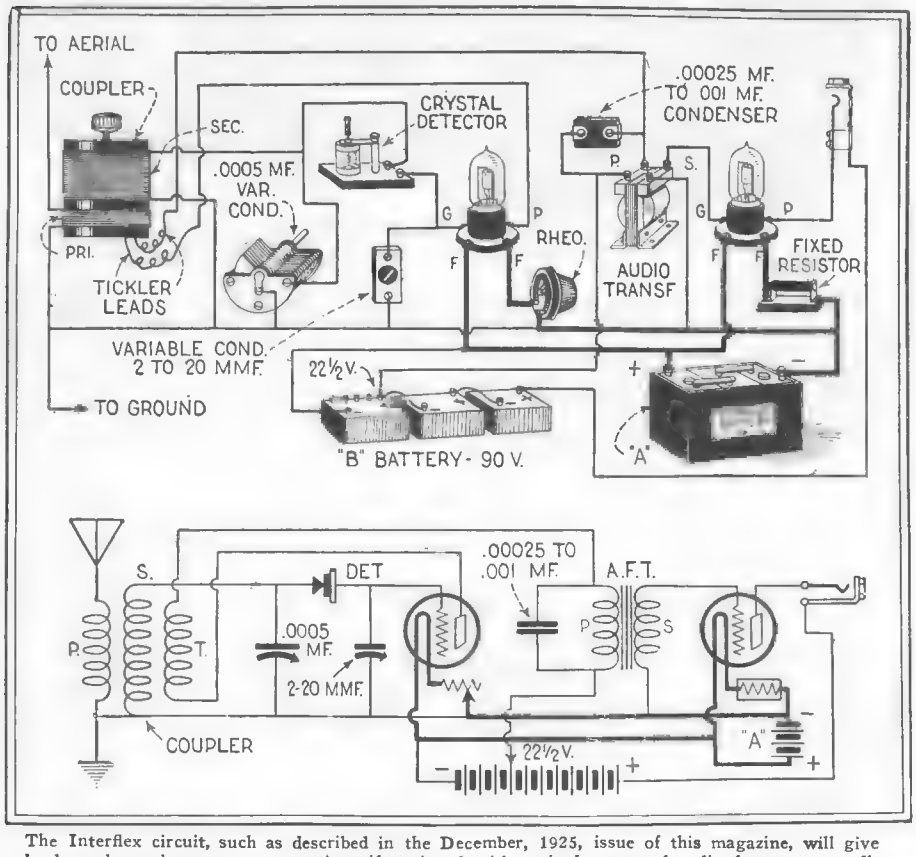
RADIO ORACLE

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 50c is made for all questions where a personal answer is desired.

INTERFLEX WITH A. F.

(423) Q. 1. Richard Savage, Hoboken, N. J., has built one of the one-tube regenerative Interflex receivers described in the December, 1925, issue of SCIENCE AND INVENTION and has had such good results with it that he desires to add an additional stage of audio frequency amplification so that "DX" stations can be brought in with greater volume. He asks how this should be hooked up.

A. 1. In these columns we show both schematic and picture diagram of the Interflex receiver with an additional stage of audio frequency amplification. The additional tube should be very easy to add as the connections are not at all complicated. Use a well made A.F. transformer with about a 3 to 1 ratio between the two windings.



The Interflex circuit, such as described in the December, 1925, issue of this magazine, will give loud speaker volume on many stations if equipped with a single stage of audio frequency amplification. The complete circuit for this work is shown in the diagram above.

BALANCING TUBES

(424) Q. 1. J. B. Bennett, Honton, Kan., asks how to determine what tubes will be best to use in certain parts of a Super-Heterodyne receiver.

A. 1. We would suggest that you try balancing your tubes in the following manner:

Remove all tubes from the set except the last detector tube and last intermediate radio frequency amplifier tube. Light both tubes and keep all values constant, with the exception of the potentiometer. Varying the potentiometer arm should result in the production of a rushing sound, or a click, at one position of the arm. This denotes oscillation of the tube. Three tubes that oscillate at exactly the same spot (position of the potentiometer arm) are to be used as intermediate frequency amplifier tubes. All tubes to be tested are placed in the last intermediate frequency amplifier tube socket, one after the other, the one detector tube being used throughout the test. A tube that oscillates readily will make a good oscillator tube. Tubes that will not oscillate at all are not very good. After these general characteristics of your tubes have been found you may place them in the set in the positions determined as desirable for them.

VOLUME CONTROL

(425) Q. 1. D. B. Browilow, Middletown, Conn., asks: What value of variable resistance should be used for controlling the volume of a second stage amplifier, when it is connected across the primary or the secondary of the second audio frequency transformer?

A. 1. The resistance you mention should have a variable value of from 10,000 to 100,000 ohms.

INTERPLANETARY RADIO

(426) Q. 1. Felix Grandich, New York, N. Y., asks: When various attempts have been made to communicate with the planets by radio, is a ground connection used, and if so, why?

A. 1. In the proposition you mention, a ground or counterpoise must be used. The reason for this is that a condenser must be formed at the transmitting end and this is realized by the use of an aerial as one plate and the ground as the other.

Q. 2. Is the "radio roof" or Heaviside layer an accepted explanation for various vagaries of radio waves?

A. 2. The "radio roof" is still the subject of a mooted question among various radio experts and in our opinion, it is a quite probable explanation of the eccentricities of short waves.

REPETITION IN SUPER-HET.

(427) Q. 1. L. G. Benjamin, East Wallingford, Vt., says that he has built up a Super-Heterodyne receiver and finds that he can tune in the same station on two different points on the oscillator dial. It sometimes happens that certain stations can be tuned in on three settings of the dials. The Super-Heterodyne in use is of the Tropadyne type.

A. 1. It is usual to tune a station in at two different points on the oscillator dial. We cannot suggest any method for preventing the receiving of a station at two different settings.

If a station is received *three* times, the extra reception may be due to one of the Tropaformers being off tune or to one or both of the variable condensers being of rather poor construction and resulting in an irregular capacity. It may also he due to the fact that you hear a harmonic of the wave.

CHANGING SET

(428) Q. 1. W. A. Bazar, Painesville, Ohio, is using a loose coupled type of regenerative receiver and wants to know if we would recommend him to change it to one employing a variometer for tuning.

A. 1. We would not advise you to change the receiving set that you mention to one employing a variometer for tuning. The results would be far from satisfactory, as the circuit would not be very selective and it would radiate more than the one you mention in your letter.

COMBINATION TRANSMITTER AND RECEIVER

(429) Q. 1. H. F. Gustine, Jr., New Orleans, La., mentions a circuit of a standard combination transmitter and receiver and asks what "B" battery voltage should be applied to a fairly hard tube being used in the circuit.

A. 1. A "B" battery voltage between 100 and 250 volts should be used. The higher the voltage, up to the limit of the tube, the better the transmission will be.

Q. 2. What size coils should be used in this circuit for working on the upper amateur band of wave-lengths?

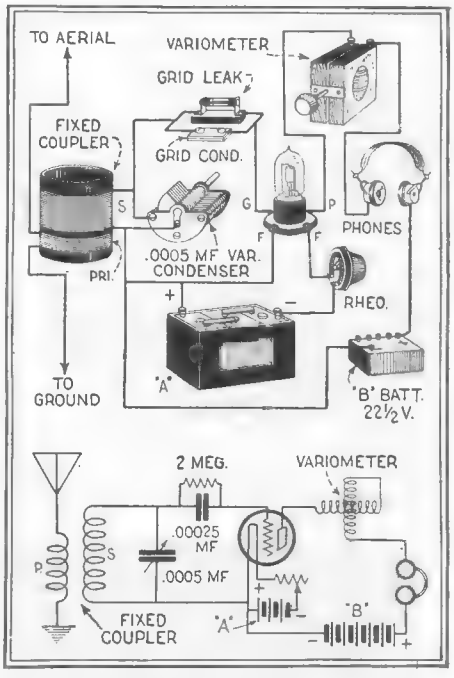
A. 2. The primary coil in this circuit should consist of about 19 turns of No. 16 wire, wound on a 4-inch diameter form. The tickler should consist of about 12 turns, wound on a smaller form and arranged so that it can be rotated within the primary. It would be advisable for you to add a .00025 mf. variable condenser in this circuit, connecting it across the oscillator coil. This will aid considerably in tuning. Kindly note that you cannot operate this set as a transmitter unless you obtain an amateur's transmission license. Furthermore, it can only be used legally for phone transmission on a wave-length band of 170 to 180 meters.

Q. 3. What kind of an aerial should be used for transmission between 150 and 200 meters?

A. 3. Regarding the aerial for use in connection with this set, we would advise a 1, 2 or 4 wire affair, 50 feet long over all and situated as high as possible. Either a ground or counterpoise can be used and for transmission, the latter will probably give the best results. It should be the same size as the aerial and should be located about six or eight feet from the ground. It need not necessarily be placed directly under the aerial, but can be run in any convenient direction. It is to be connected to the ground binding post of the combination set, whereupon the ground itself is not used for transmission.

SIMPLE RECEIVER

(430) Q. 1. James Moore, Chicago, Ill., wants to know how to hook up a fixed coupler of the same type as used in tuned radio frequency amplifiers with a variable condenser, a variometer and a vacuum tube.



A very simple yet selective and stable single tube regenerative circuit is shown above. This set is easy to hook up as well as to operate.

A. 1. This set can be hooked up by following the diagram given in this column. The results will be very good and the set will be quite selective. Simplicity is also a feature inasmuch as only one tuning control and one regeneration control are necessary.

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ALL-WAVE SET

(431) Q. 1. L. C. Naeser, Hampton, Va., says that his Neutrodyne receiver does not operate satisfactorily over the entire band of broadcast wave-lengths. Other than a slight squeal on some low waves, the results are quite satisfactory, but he desires to know how even this effect can be done away with.

A. 1. Since you say that the results with your Neutrodyne set are good, we would not advise you to change the set further. When a Neutrodyne set is slightly unbalanced, the signal strength is usually greater than when it is properly neutralized because of the losses found in the neutralizing condensers. Here is where the whole trouble in your set lies. The capacity in your neutralizing condensers will only control the set over the band in which you say you get perfect neutralizing. Below this band this neutralizing effect is lost and the result is that the set tunes in "on the squeal," in the same manner as a regenerative receiver.

We would advise you to refer to the article entitled, "A Novel Six-in-One Receiver," which appeared in the November, 1925, issue of this magazine. A Neutrodyne receiver that is properly neutralized over its entire range is described therein.

GALENA

(432) Q. 1. E. T. Anderson, Kenilworth, Mont., asks: What is galena? Is it a natural or synthetic product?

A. 1. Galena is a natural mineral found in large deposits and the chemical name of it is lead sulphide. It can be purchased from any radio supply store. Lead sulphide can be made artificially by chemical processes and, if properly made, will receive.

VARIOMETER TROUBLE

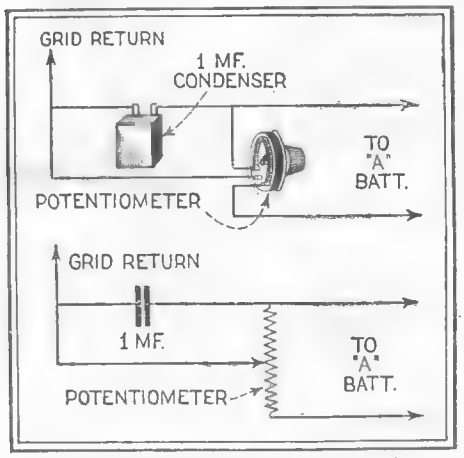
(433) Q. 1. L. T. Wick, New Ulm, Minn., is using a variometer in the plate circuit of a vacuum tube set, but says that the addition does not seem to make any difference in the operation of the set in question, inasmuch as the set does not work any better than it did before the variometer was inserted. He asks our assistance.

A. 1. Your variometer should function if connected into the circuit correctly and if the variometer is perfect. If the variometer is open circuited, the set would not work at all. If short circuited, the set would operate as you describe. If your variometer is too small, the results would also be similar.

GRID RETURN

(434) Q. 1. Frank Bartlett, Houston, Texas, asks if a fixed condenser should be used in a potentiometer circuit and if so, how it should be connected.

A. 1. Such an addition is quite desirable as it provides a by-pass for the R.F. current around the high resistance potentiometer. The condenser is connected from the center post of the potentiometer to one or the other of the two remaining terminals. The connections are clearly shown in the diagram in these columns.



A fixed condenser connected to a potentiometer as shown above is a desirable addition.

"C" BATTERY

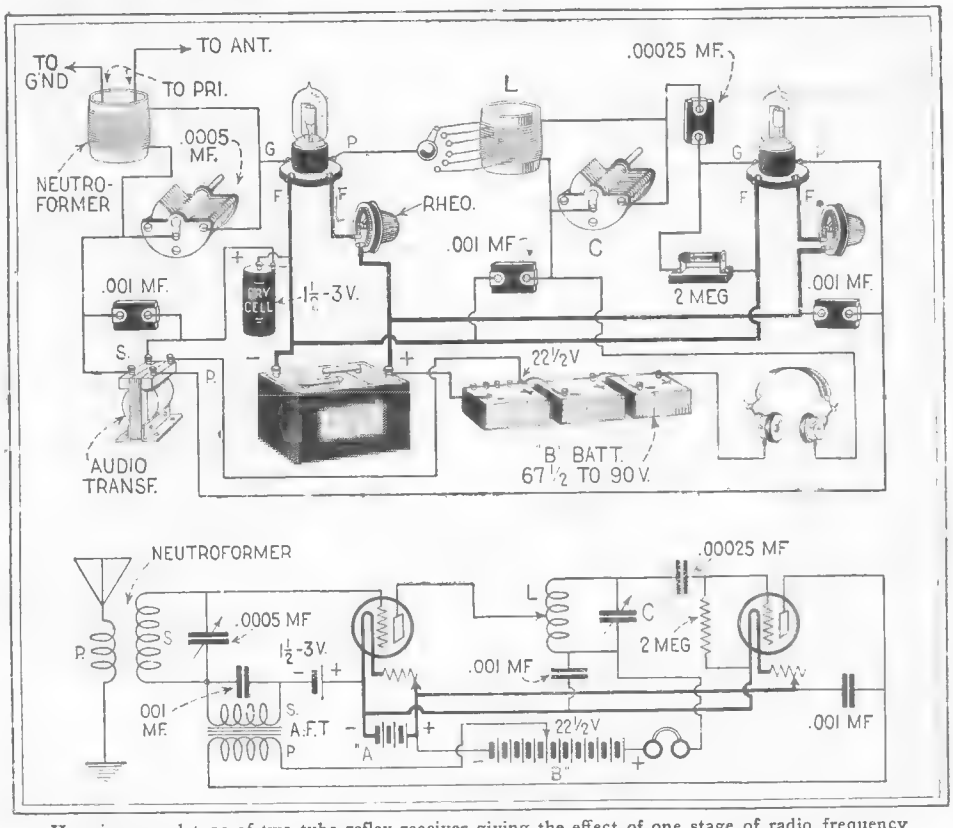
(435) Q. 1. George Kinsman, Chicago, Ill., asks whether or not the use of a "C" battery will decrease the "B" battery consumption.

A. 1. By applying a certain voltage, which must be determined by experimentation, to the grids of the amplifier tubes, a decrease in "B" battery current consumption will be noticed. To make this addition, remove the amplifier grid return leads from the negative "A" connections. Connect the amplifier leads together and to the negative side of the "C" battery. Connect the positive side of the "C" battery to the negative side of the "A" battery. Try voltages of from 3 to 6 volts for the "C" battery and use the voltage that seems to give the best results.

PORTABLE SET

(436) Q. 1. Andrew S. Edison, Cleveland, Ohio, asks for some details on building a portable set that can be incorporated in a suitcase.

A. 1. A radio receiving set employing two or three stages of radio frequency amplification either tuned or untuned, a detector and two stages of audio frequency amplification may be incorporated in a suitcase and used with a loop aerial to very good advantage. Standard parts may be used in a set of this nature and circuits for the same have been published in past issues of this magazine. We regret to say that we do not have any blueprints covering a set of this nature.



Here is a novel type of two tube reflex receiver giving the effect of one stage of radio frequency amplification, detector and one stage of audio frequency amplification. Use good instruments in a set of this nature and you will be assured of good results.

REFLEX

(437) Q. 1. George Watkins, San Francisco, Calif., asks for a reflex circuit not employing a crystal detector but in which the first tube is tuned by a standard neutroformer and the detector circuit by the tuned impedance method.

A. 1. The required circuit will be found in these columns as requested. The antenna circuit is tuned by a neutroformer and the coil, L, and the condenser, C, constitute the tuned impedance circuit for the detector tube. The coil, L, consists of approximately 60 turns of No. 22 D.C.C wire on a 3½-inch tube and the winding should preferably be tapped every 10 turns; the amount of inductance in the plate circuit is controlled by means of a switch. The condenser, C, has a capacity of .0005 mf. The rest of the instruments in this circuit are standard.

REFLEX TROUBLE

(438) Q. 1. Edward Evers, St. Louis, Mo., says that he has built a reflex circuit but cannot get any results with it. He describes his trouble and our composite reply is given below.

A. 1. We give you the following suggestions in order to clear up the difficulty you are experiencing with your receiver. Try removing the by-pass receiver across the phones. It may be shorted. Make sure that you have a sensitive crystal. Perhaps your sole trouble is due to a very poor contact on the crystal or that it is entirely worthless. Clean the tube contacts, tighten up the variable condenser bearings, blow off the dust from the plates, see that the connections are tightly soldered and make sure that you are using a good grid leak. Try increasing the plate voltage to the amplifier tube and try reversing the polarity of the "A" battery.

DRY CELL TUBES

(439) Q. 1. William J. Baker, New York City, asks what "A" and "B" voltages should be used on the standard WD-12 tubes.

A. 1. When a WD-12 is used in a set, a standard No. 6 dry cell will give very good results as the "A" battery. The "B" battery should be as high as will give good results, and will vary somewhat in accordance with the particular tube used. Some of these tubes will stand up to 80 volts on the plate, while others will not operate satisfactorily on more than 22½ volts. We would, therefore, suggest that you experiment along this line, starting with 16 volts and noting the results. Increase the plate voltage until the signals do not get any louder. You will find that this point is the best for the operation of the tube you are trying out.

"B" ELIMINATORS

(440) Q. 1. C. G. Lindahl, Seattle, Wash., refers to the "B" eliminators described in the September, 1925, issue of this magazine and asks whether or not they can be used on all types of sets.

A. 1. All of the "B" eliminators with the exception of the first one described can be used with practically any radio receiving set. In the case of the first eliminator, this cannot be used on a set in which the filament circuit is grounded. If such is the case, the connection between the filament circuit and the ground must be removed before the "B" eliminator is connected to the set.

EXPERIMENTAL LOOP RECEIVER

(441) Q. 1. Wm. H. Schwingel, Dansville, N. Y., has a Neutrodyne receiver on hand and desires to make up another set with a loop aerial that can be used for experimental purposes. He asks our advice as to the best type of circuit to employ in this experimental set.

A. 1. Possibly the best three-tube receiver for you to make up for experimental use on a loop antenna would be one using two stages of tuned radio frequency amplification and a vacuum tube detector. If you want to do so, you can convert your Neutrodyne so that it can be used on a loop by disconnecting the secondary or grid and filament connections of the first neutroformer and connecting the two terminals of the loop to the set. In other words, the loop is connected in place of the secondary of the first neutroformer. The variable condenser is left in the circuit and will be found to be connected across the loop. The condenser will then tune the loop circuit in the same way as it formerly tuned the first radio frequency circuit.

A satisfactory loop may very easily be homemade. No special precautions are necessary as insulated wire is usually used, but if you desire to make it of the most efficient type, provide hard rubber or bakelite spacers for the wires.

ULTRADYNE QUERIES

(442) Q. 1. J. P. Holloway, Hazelwood, Pittsburgh, Pa., asks in what direction the coils used in an Ultradyne receiver are wound.

A. 1. All coils in the Ultradyne are wound in the same direction.

Q. 2. If I wish to use only a loop, should I use the jack usually shown in the tuner circuit?

A. 2. If you are going to use only the loop, we would advise you to leave out the jack and make connections to binding posts instead. This will eliminate the possibility of inefficiency due to a high loss plug or jack.

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Non-Sc(i)ence

NEWTON'S LAW REFUTED

The following is taken from the *Kansas City Star* of July 25th: "An 8-inch plank, 20 feet long, fell today from the third floor of the Commercial National Bank Building, under construction in Kansas City, Kan., and **struck four men working on the fourth floor."**

Now, either the fourth floor was below the third, or else the building was being built upside down. If neither of these conditions hold, a Gernsbackian Anti-gravitational Screen must have been used. I am going out to investigate.—*Alvin Ackerman.*

OH, RATS!

The *New Orleans Times-Picayune* of July 4th, 1925, gives the following interesting report: "Theresa Ascani . . . . was reported in an improved condition . . . . after it was thought that she would die from **rat poison which she found crawling about the house while her mother was absent."**

Our famous insecticide manufacturers should immediately get after this type of rat poison and find some means of exterminating it, because when rat poison starts to crawl about the house, it is time something was done about it. The worst of it is that the crawling commences while the rat poison's mother is absent.—*F. R. Kiedinger.*

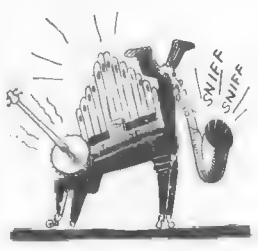
WHERE WILL THE LIGHT COME FROM?

In advertising a benefit festival the *Grafton* (W. Va.) *Sentinel* says: "Refreshments of all kinds will be served. **Music will be furnished by C. E. Warren with Delco light system."**

Aint it wonderful what they can do with 'lectricity nowadays? If he used the Delco light system for furnishing music, what is he going to use to furnish the light?—*Bill Doll.*

JUMP FRITZ

The following appeared in the Lost and Found columns of the *Denver Express* in their July 27th issue: **"Pipe organ, saxophone, banjo answers name Fritz.** Reward. 4928 W. 29th Ave."



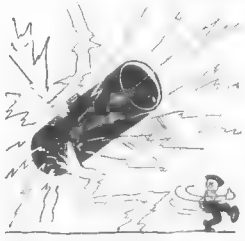
We have heard a great many musical instruments called by name before and often when a string breaks or a reed goes wrong the instruments were called by other than their right names much more descriptive than the word Fritz. We wonder whether they are separate instruments or one hybrid instrument combining organ, piano, saxophone and banjo which answers to the aforesaid appellation.—*Sylvia Lampert.*

Money for Science Mistakes

The newspapers throughout the country, as well as the magazines, occasionally err. Sometimes these errors are misprints. At other times they are pure scientific misstatements. If you happen to see any of these humorous mistakes in the press, we will be glad to have you clip them out and send them to us. Give the name of the newspaper or magazine in which the error appeared and accompany the inclosure with a few humorous lines. The most humorous ones will be printed in this department, and for each one accepted and printed we will pay $1.00. No NON-SC(i)ENCE entry will be accepted, unless the printed original accompanies the same. All NON-SC(i)ENCE entries must be scientific and addressed to:

Editor, NON-SC(i)ENCE Dept., c/o Science & Invention Magazine, 53 Park Place, New York City.

SPEED PLUS



A headline in the Bicknell *Daily News* (Indiana) of August 12th, 1925, reads as follows: **"Lightning Bolt Hit by Oil Tank."**

We have often heard of a lightning bolt hitting an oil tank, but this is the first time we have heard of a tank hitting a lightning bolt. Whoever hurled the oil tank at the lightning bolt must have been a clever twirler, and as his speed is great enough to catch the lightning bolt napping, he should make a first-class pitcher for the Giants.—*Aubrey McClaflin.*

SHOULD BE BAILED OUT

An article in the *Chicago Daily Tribune* of July 23, 1925, reads as follows: "An ocean-going yacht loaded with Canadian Scotch whiskey was captured last night on the Mississippi River near Medley, Mo., by Sheriff King of Charleston, Mo. The yacht, valued at $50,000, **is held in the Charleston jail."**

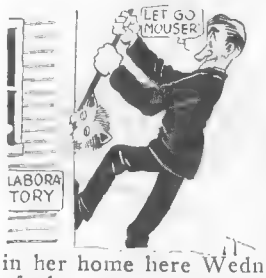
That must be some prison where they can lodge an ocean-going whiskey-laden yacht.

The fact that the crew were also detained indicates possibly that they were to polish the brass. Besides, what good is a ship without a crew? It is possible that the yacht will soon escape, because many vessels (schooners and growlers) have been known to easily pass over the bars.—*Alvin Spavin.*

ELASTIC FORESTS

In the *Boys' Life* for September we find the following line: "A TEN-INCH BOARD WAS CUT TO A LENGTH OF TWO FEET." We certainly are surprised to know that a ten-inch board will stretch to more than twice its original length. They must have used wood from a rubber tree. That accounts for the stretching. On the other hand, by cutting the wood in a zig-zag fashion, one could possibly stretch the ten-inch board to the required length. I have never tried the experiment except with paper. Will someone try it with wood and let me know what happens?—*Henry L. Despard, Jr.*

PRY, PRY AGAIN



The following item was taken from the August 23, 1925, issue of the *Arizona Republican,* printed in Phoenix, Ariz.: "The woman was bitten by the cat while working at an ironing board in her home here Wednesday. The head **of the cat was pronounced that of an animal with rabies after examination at a pathological laboratory, being pried loose with difficulty."**

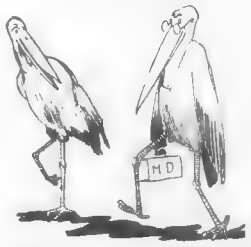
We wonder whether it was the head of the cat, the rabies or the pathological laboratory which was pried loose with difficulty. If it was the laboratory, from what was it pried loose? It must have been a very interesting exhibit, nevertheless.—*K. Morgareidge.*

EYE-EYE

In the October *Smart Set* the following appears: "A long, long whistle came from Don Kelland. His **blonde eye broke** knitted and he shook his head as if he had suddenly solved something in his mind."

Shaking one's head is evidently a refined way of expressing contempt for an eye which has such a mechanical defect that it breaks knitted. This eye being blonde, the other might have been brunette. I am still trying to find out what breaking knitted is. I know a break can knit, but I am not aware of how a blonde eye "broke knitted."—*S. Wick.*

DOUBLE JOINTED



In the *St. Louis Globe-Democrat* of June 28th, we find an illustration of a stork. The leg of this stork is bent the wrong way. Evidently the heat has not only affected the **stork** as far as his ability to carry out his duty is concerned, but has also affected his anatomical structure.—*Ed. Holm.*

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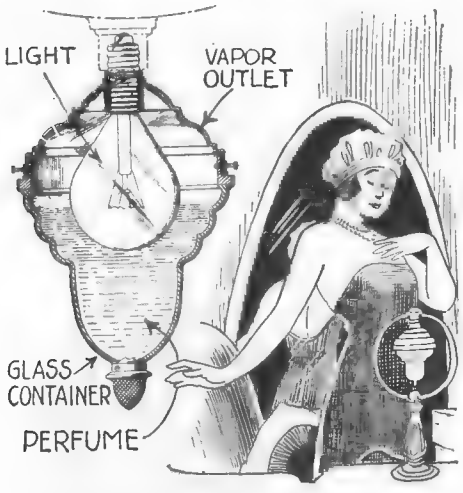
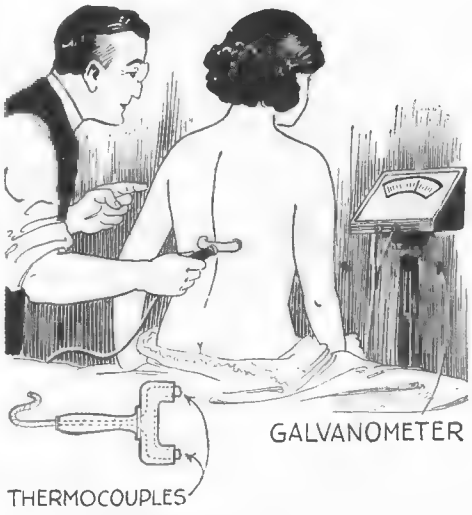
LATEST PATENTS

Perfume Vaporizer



No. 1,544,212 issued to J. G. Blaschke protects the design and construction of a novel perfume vaporizer of the type shown in the above illustration. An electric light bulb incorporated in the assembly gives a novel appearance to the vaporizer and also provides heat which assists the vaporization of the perfume, the vapors from which escape through small outlet holes shown. The unit is readily taken apart so that the perfume can be replenished.

Chiropractor's Aid



No. 1,552,284 issued to D. D. Evins relates to a novel indicating and detecting instrument that is to be used by chiropractors in the process of spinal analysis. The complete apparatus consists of a sensitive galvanometer and a small device known as the detector, incorporating one or a series of thermocouples, according to the method by which the detector is to be used. The type shown incorporates a series. According to chiropractic theories, subluxated vertebrae cause nerve pressure and a consequent increase in heat at the point of pressure. The thermocouples being in a balanced circuit indicate the presence of such heat by means of the current generated acting upon the galvanometer. The latter instrument is of the type where zero reading is at the center of the scale and consequently deflections to the left or right indicate that the nerve pressure is to the left or right of the spinal column.

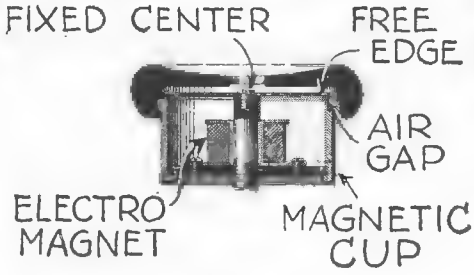
Battery Carrier

No. 1,540,155 issued to Herbert H. Wydom and Joseph E. Perrault describes a novel battery carrier by means of which a storage battery can be conveniently transported. The patent specifications show the drawing reproduced in the upper left-hand corner above in which the handle is attached to two pivoted clips which are so designed as to engage in the handles usually found on storage battery containers.

Writing Light

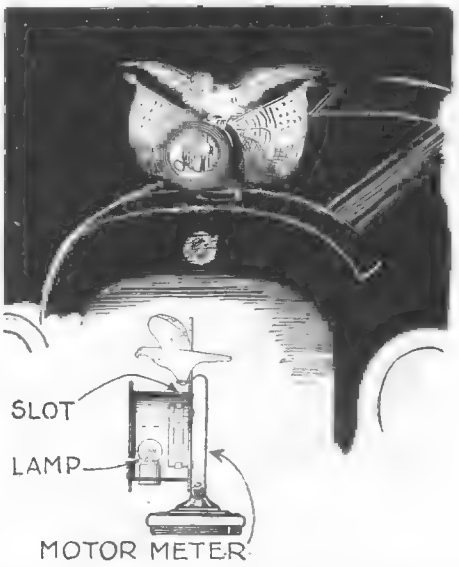
No. 1,541,014 issued to Eduard Wagner describes a novel device that is to be used in connection with an ordinary tubular flashlight so that the combination can be used for writing in the dark. The attachment is merely a pressed metal reflector and writing surface which is equipped with two clips to be pressed over a tubular flashlight. Turning on the latter causes part of the light to be reflected up and backward onto the writing surface.

Telephone Receiver



No. 1,544,313 issued to Jackson B. Gumaer relates to a novel type of telephone receiver in which the center of the diaphragm is fastened rigidly to a central pole and in which the edge of the diaphragm is free to vibrate. A winding is placed around the single pole and is energized by the incoming current. The metal shell is part of the magnetic circuit and the changes in the strength of the magnetic field cause the edge of the diaphragm to vibrate in exact accordance with the current pulsations. The width of the air gap is readily changed by changing the position of the central pole.

Auto Ornament



No. 1,544,160 issued to John I. Kelley covers the construction of the unique ornament to be used in connection with a motor heat indicating device. Placed within the assembly as shown is an electric light bulb which illuminates the heat indicating device and makes it visible to the driver and which also illuminates the rest of the ornament which, in the case illustrated, are an eagle and two flags.

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Scientific Humor

A MEATY PROPOSAL

I never sausage eyes as thine
And if you'll put your hand in mine
And liver 'round me every day
We'll seek some ham-let far away
We'll meat life's frowns with love's caress
And cleaver road to happiness.
—*Alexander Andulsky,* Reporter No. 16644.

PLANT THEM NEAR BED SPRINGS

"Isn't it wonderful what can be accomplished in this day and age?" a woman asked of her neighbor.

"Indeed it is," she was answered.

"Why, do you know, they now sell shoe trees!"—*Edna May Bush.*

A CHEAP JOKE

During the recent eclipse, a Scotchman was seen running to the Western Union office in hopes of sending a night letter.—*Anthony Chufi.*

NOTHING LEFT TO SEE

A girl, a great lover of nature, approaching a fisherman, said: "Ah, sir, how well you must know the face of Nature, and know all its false moods. Have you ever seen the sun sinking in such a glare of glory that it swallowed up the horizon with fire?

"Have you not seen the mist gliding down the hilltop like a spectre? Have you never," she went on impassionately, "seen the moon struggling to shake off the ragged, rugged storm cloud?"

"No, miss," responded the fisherman, "I used to see them things, but now the country's dry."—*Anthony Libertore.*

A RECORD TALKER

"Your daughter talks a great deal, doesn't she?"

"Yes, I think she must have been vaccinated with a phonograph needle."—*M. Kipp.*

LAID TO ORDER

MARY (at breakfast table): "Mother, how do the hens know the size of our egg cups?"—*Lambros D. Callimahos,* Reporter No. 3503.

BELONGS IN AN APE-IARY

EVO: "It's too bad Bryan died without seeing you."

LUTION: "Why do you say that?"

EVO: "He would have admitted his mistake about the evolution theory."—*B. P. Bliven.*

DEAD MEN TELL, ETC.

LADY: "You're sure one bottle will do the work?"

CLERK: "It must do, lady, nobody has ever come back for the second."—*Lambros D. Callimahos,* Reporter No. 3503.

SURE DOES

PROF: "Your answer is as clear as mud."

STUDE: "Well, that covers the ground, doesn't it?"—*Lambros D. Callimahos,* Reporter No. 3503.

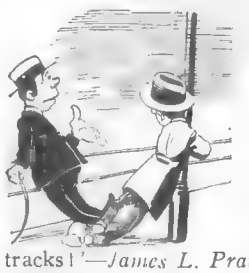
FIRST PRIZE $3.00

HE DOES NOT KNOW

EMPLOYER: "Does he know anything about electricity?"

EMPLOYE: "No, he even wonders what kind of a nut belongs on a thunderbolt."—*L. Keiser, Jr.,* Reporter No. 27612.

VERY OBSERVING



FIRST DRUNKEN STUDE: "A shtreet car just pashed yere."

SECOND DRUNKEN STUDE: "How do (hic) yer know?"

FIRST DRUNKEN STUDE: "I (hic) can shee its tracks!"—*James L. Prather.*

INVENTORS WE HAVE MET

Brown and Smith passing insane asylum where inmate is being taken in:

BROWN: "What's wrong with that guy?"

SMITH: "That's the guy who invented a static eliminator. You put a buzzer on the circuit and it makes a noise so loud that you can't hear the static."—*Jack Jennings.*

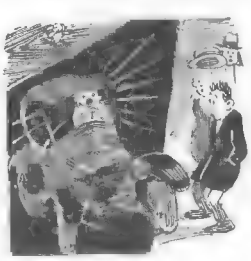
WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

NATURALLY

PROF. OF ASTRONOMY: "That star is Venus. It was named after a very beautiful woman."

SMALL VOICE IN REAR: "Was that the star the Wise Men followed?"—*Morton P. Rome,* Reporter No. 20657.



ILLUMINATING THE LAW

The supreme penalty is called for when the car carries no headlight and the driver is all lit up.—*I. Bercovitch.*

A BLOCK OF LAND

LAWYER: "My client is suing you for injuries received from a dangerous obstruction on your property."

OWNER: "Why, how did he get hurt?"

LAWYER: "He fell from an airplane and your land blocked his fall."—*Harry Boyajian,* Reporter No. 5969.

SUNSTRUCK

TEACHER: "Why is the biggest part of an iceberg under water?"

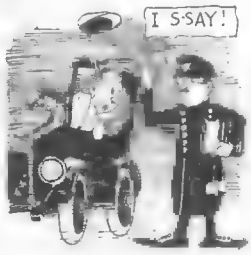
BOBBY: "Because the sun melted away the part above water."—*Harry Boyajian,* Reporter No. 5969.

SPUTTERS—THEN GOES OUT

JACK: "What makes you call Tom a 'live wire?'"

PLUG: "That's because he sputters so much."—*Wm. A. Heitler,* Rep. No. 11783.

TAPS



The motorist was a stranger in Boston. It was evening. A man approached.

"Sir," said he, "your beacon has ceased its functions."

"What?" gasped the astonished driver.

"Your illuminator, I say, is shrouded in unmitigated oblivion."

"I don't quite——"

"The effulgence of your irradiator has evanesced."

"My dear fellow, I——"

"The transversal ether oscillations in your incandescer have discontinued."

Just then a small newsboy came up and said, "Say, mister, yer lamp's out."—*Robert Elliott.*

IT MISSED THE ACCUMULATOR

Receiver—The rent collector.

Loud Speaker—Pa, when Ma bought a new dress.

Earth—What a golfer hits instead of the ball.

Ohm—Best place in cold weather.

Buzzer—The political candidate.

*Accumulator—The editor's waste paper basket.—*Ralph D. James,* Reporter No. 21127.

POROUS ARE BEST

A colored man walked into a drug store and said: "Ah want one ob dem plasters to stick on yoah back."

"I see. You mean one of our porous plasters."

"No. Ah don't mean no porous plaster. Ah wants de best yoah got."—*Clifton Ask.*

FOR UNDRESSED KIDS

The mistress of the house was returning from a party when she was met by the maid.

"The baby was very cross when you were out and I gave him some of his medicine."

"My stars! What have you given the child? He had no medicine!" cried the frantic mother.

"Oh, yes, ma'am, here it is." And she held up a bottle labeled "Kid Reviver."—*Edward D. Muir,* Reporter No. 14122.

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THE ORACLE

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

LOOPING THE LOOP

(1973) Q. 1. Raymond B. Richards, Burlington, Vt., asks us to explain just how the pilot of an airplane proceeds to loop the loop during flight.

A. 1. This seemingly dangerous and difficult feat is in reality one of the simplest possible "stunts." The only one of the airplane controls that is employed is the elevator, or horizontal rudder. The steering rudder, or vertical part of the tail, is kept in a position that keeps the plane on a straight course. The ailerons are not moved

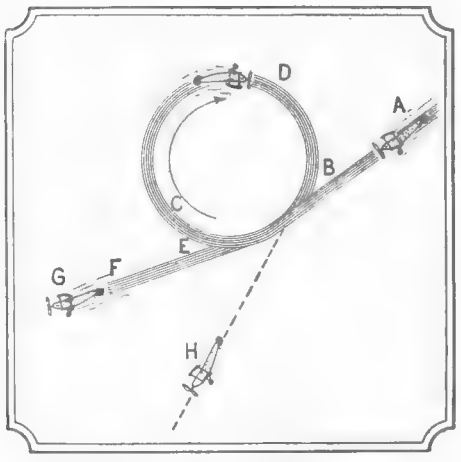


Diagram above shows how airplane loops the loop as explained in the text.

during the entire manipulation. The illustration in these columns aids in visualizing the exact procedure followed. The aviator maintains a speed of at least 75 miles an hour, although this can be even less with smaller planes.

He starts in a downward direction, as at A in the diagram, and when the point B is reached, he pulls the control stick back, causing the plane's nose to turn upward. At C the plane is well on its way to a loop and all this time the motor is kept at or nearly at full throttle. The stick, or control lever, is held back and soon the plane assumes an inverted position, as at D. Here the motor is cut off, or the throttle is nearly closed, and the plane coasts downward on the remainder of the loop. When the poiut E is reached, the stick is slowly but firmly pulled backward and the plane proceeds in the direction F and G. If the motor is not cut off at the top of the loop, but is left at full throttle, the pilot will not be able to flatten out quickly and assume a course along F, but will go downward at a greater angle from the horizontal, taking the course H. During all this time, the control stick is moved slowly and firmly without jerking. This is necessary, as irregular movements will set up great stresses in the structure of the plane and may prove dangerous. This stunt is usually done when flying into the wind and at quite an altitude.

BOTTLE SEALS

(1974) Q. 1. S. Handa, New York City, says that he has made up seals for bottles according to the directions given in the October, 1924, issue of this magazine but says that they become sticky and do not dry. He asks us to help him.

A. 1. Undoubtedly, you incorporated too much glycerine in your original mixture. Furthermore, do not forget the application of the formaldehyde and possibly you would get somewhat better or at least different results by mixing the formaldehyde directly with the glycerine and casein before applying to the bottles.

Q. 2. How can I use celluloid for coating various objects, including corked bottle tops?

A. 2. Dissolve the celluloid in amyl acetate. Make up a saturated solution, apply and allow to dry. Keep away from flame as this solution is highly inflammable.

BATTERY PLATES

(1975) Q. 1. Donald L. Cameron, Strathroy, Ontario, Canada, says that he has done considerable experimental work with the construction of storage battery plates and that none of the formulas that he has come across so far have proven to be satisfactory. He asks: Can you not help me out further in this work?

A. 1. The following, though considered a trade secret, is a method used by most battery repairmen:

Take red lead 90%, ammonium sulphate 10%, by weight; mix well, breaking up all lumps or crystals. Make into a thick paste with 26° ammonia. Make no more than what can be applied in two or three minutes. Apply with a wooden paddle to the positive plates. Place the pasted plates between sheets of blotting paper, and weight heavily for 20 minutes in order to remove all surplus moisture. When removing the blotting paper, be careful that the paste is not removed also. Now place the plates in the sunlight, and allow to dry for 24 hours.

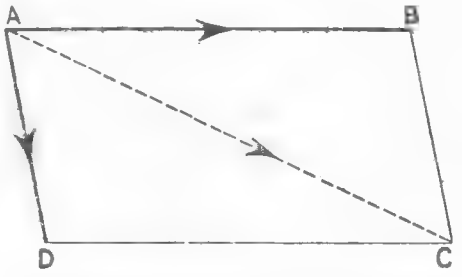
The same procedure should be followed with the negative plates, but using yellow lead oxide, 94%, and ammonium sulphate 6%, by weight, and making a paste with 26° ammonia 85%, and glycerine 15%, by weight.

After drying in the sun, and removing all surplus paste, the positive plates are ready for sulphating. This is accomplished by making a solution of sulphuric acid 14% and water 86%. The positive plates are dipped into this solution, one at a time, withdrawn, and after three or four seconds again dipped. This is repeated three or four times, and the plates finally left in the solution for 18 to 20 hours, no more. The plates are then washed in several changes of water for two or three hours. The negative plates do not need sulphating, as they are hard enough without it.

The plates are now placed in the battery box before the electrolyte is added, and connected to the charging source. Electrolyte is added and the battery charged slowly. If the battery is charged and discharged slowly several times, plates removed and washed and new electrolyte used, the life of the battery will be greatly lengthened.

RESOLUTION OF FORCES

(1976) Q. 1. Joseph H. Bernard, Newark, N. J., asks us to explain and illustrate what happens when two forces are acting upon the same object at an angle to each other.



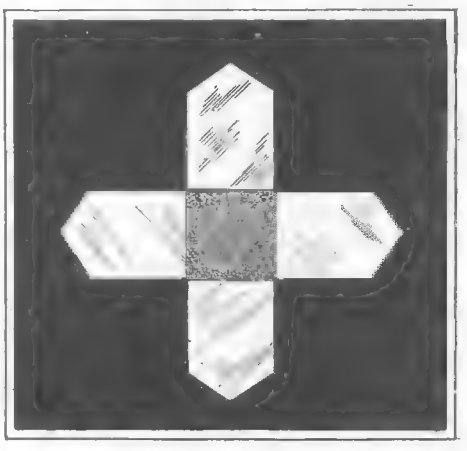
A resolution of forces at angles is clearly depicted in diagram given above.

A. 1. Referring to the diagram in this column will explain just what happens in a case of this type. Suppose that two forces act upon point A, one of them tending to either pull or push the object at A in the direction of B. The other force acts toward D. All that we have to do to show the direction in which these two forces will tend to force the object is to construct a parallelogram, ABCD, and construct the diagonal, AC. This latter line shows the direction and force in and with which the object will move from A. The length of the sides AB and AD are determined by the force in the two directions.

POLARIZED LIGHT

(1977) Q. 1. Richard Shelby, Indianapolis, Ind., asks us to explain polarized light.

A. 1. We must first understand that light is, under ordinary conditions, a series of vibrations in the ether which are taking place in an up-and-down and a right-and-left direction as well as in all oblique directions between the two. Each of these vibrations is, of course, at right-angles to the forward motion of the light wave toward the observ-



When viewed through two tourmaline crystals, light produces the effect illustrated above.

er's eye. One of the simplest ways of showing the polarization of a light wave is to first look through a single crystal of tourmaline. Under these conditions, the light passes unobstructed, and if we superimpose another crystal of the same substance upon the first one, and parallel to it, light still passes. If, however, we placed the crystals at right-angles to each other, as shown in the illustration in this column, light will only pass through the four projecting ends, but not through the center. This is because of the fact that tourmaline and some other transparent substances are of such construction that they will shut off or refuse to transmit all of the vibrations at right-angles to the direction of the light wave except those parallel to the long axes of the crystal. Therefore, when the long axes of the crystals are at right-angles to each other, all light vibrations are cut off, and this quenching effect of some waves and the transmitting of others in one plane only is what is known as polarization.

COLORING FLOWERS

(1978) Q. 1. A. T. Kimball, Rockland, Me., asks: How are flowers artificially colored in various shades?

A. 1. A method employed by florists to impart a green color to the petals of "carnation pinks" consists in allowing long-stemmed flowers to stand in water containing a green aniline dye. When the flowers are fresh they absorb the fluid readily, and the dye is carried to the petals.

Where the original color of the flower is white, colored stripes can be produced upon the petals by putting the cut ends into water impregnated with a suitable aniline dye. Some of the dye will then be taken up by the capillary action of the stem and deposited in the tissue of the petal.

If flowers are placed over a basin of water containing a very small amount of ammonia in a bell glass, the colors of the petals will generally show some marked change. Many violet-colored flowers when so treated will become green, and if the petals contain several tints they will show greens where reds were, yellows where they were white, and deep carmine will become black. When such flowers are put into water they will retain their changed colors for hours. If violet asters are moistened with very dilute nitric acid, the ray florets become red.

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ANTI-FREEZING SOLUTIONS

(1979) Q. 1. Wm. R. Anderson, Minneapolis, Minn., asks: Kindly outline all of the available and practical methods of preventing the freezing of the cooling solution in an automobile radiator and cylinder jackets when the latter is being used in a cold climate and under freezing conditions.

A. 1. A practical manufacturing chemist of wide experience gives this:

A saturated solution of common salt is one of the things to use. It does not affect the metal of the engine, as many other salts would, and is easily renewed. It will remain fluid down to 0°F., or a little below.

A mixture of equal parts of glycerine and water has the advantage that it will not crystallize in the chambers, or evaporate readily. It is the most convenient solution to use on this account, and may repay the increased cost over brine, in the comfort of its use. It needs only the occasional addition of a little water to make it last all winter and leave the cooling system clean when it is drawn off. With brine an incrustation of salt as the water evaporates is bound to occur which reduces the efficiency of the solution until the crust is removed. Water frequently must be added to keep the original volume, and to hold the salt in solution. A solution of calcium chloride is less troublesome so far as crystallizing is concerned, but is said to have a tendency to corrode the metals unless the pure salt is used. If you use glycerine the solution will last for two or three winters.

Anti-freezing solution for automobiles: Mix and filter 4½ pounds pure calcium chloride dissolved in a gallon of warm water and put the solution in the radiator or tank. Replace evaporation with clean water, and leakage with solution. Pure calcium chloride retails at about 8 cents per pound, or can be procured from any wholesale drug store at 5 cents.

Anti-freezing, non-corrosive solution: A solution for water-jackets on gas engines that will not freeze at any temperature above 22° below zero (F) may be made by combining 100 parts of water, by weight, with 75 parts of potassium carbonate and 50 parts of glycerine. This solution is non-corrosive and will remain perfectly liquid at all temperatures above its congealing point.

Alcohol (wood or denatured) is also a good material to use for preventing automobile radiators from freezing. For medium temperatures, down to 15° F., use 1 part of alcohol to 5 parts of water. For temperatures to zero F., use 1 part of alcohol to 2½ parts of water. For temperatures down to 20° below zero, use 1 part of alcohol to 1½ parts of water.

TEAR GAS

(1980) Q. 1. W. Gatt, New York City, refers to an article appearing in the September, 1925, issue of this magazine in which home-made tear gas bombs are mentioned. He asks for further details on this subject.

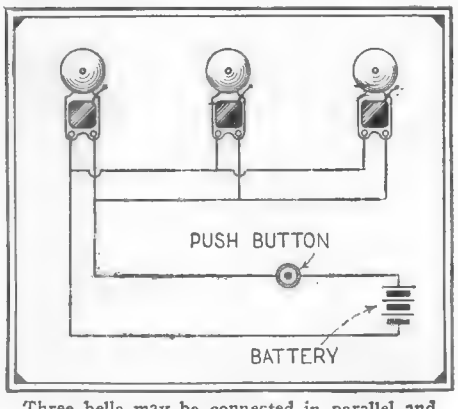
A. 1. The author of the article, Mr. Raymond B. Wailes, replies as follows:

"The home-made tear gas bombs described by me in SCIENCE AND INVENTION are easy to make, and make very effective devices for the home. They consist of a light weight bottle filled with a solution of formaldehyde. This formaldehyde solution can be purchased in many drug stores. It is already made up for you, consisting of about 57% of formaldehyde gas in water. Simply use this purchased formaldehyde solution direct in the light-weight bottle. You can also hold the tip of a burnt out electric bulb under the liquid and snip the tip off at the end. The solution will then fill the exhausted space within and can be sealed by the application of several drops of sealing wax over the broken tip."

BELL CONNECTIONS

(1981) Q. 1. George Koomis, Miami, Fla., wants to connect three or more electric bells in one circuit, using the same battery and the same push button to actuate all of them. He asks how the bells should be connected.

A. 1. Assuming that the battery is of the voltage required to operate one bell alone, the bells must be connected in parallel, as shown in the diagram in this column.

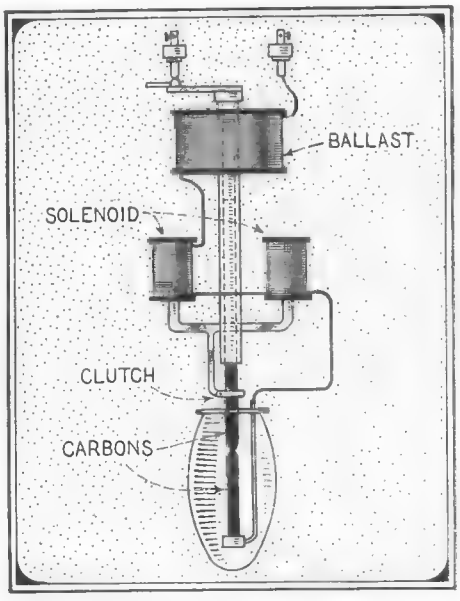


Three bells may be connected in parallel and operated from one battery as above.

ARC LIGHTS

(1982) Leonard Bradley, St. Louis, Mo., has noticed arc lights flickering and going out and then lighting up again automatically. He is aware of the fact that arc lights must be started by striking the two carbons together and asks how this is accomplished automatically.

A. 1. The diagram in this column shows a simplified view of an automatic self-regulating arc light. When the current is shut off, the solenoids are not energized and the upper carbon falls, actuated by gravity, against the lower one. When the current is turned on, the solenoids are actuated and they draw the upper carbon upward, striking the arc at the same time. When the gap becomes almost wide enough to cause the arc to break, the current in the circuit tends to fall, thus reducing



This diagram shows in detail the construction of an automatic arc light and in the text will be found a complete description of the operation of this light.

the strength of the solenoids and maintaining the upper carbon in position. If the arc should break, the upper carbon immediately falls, closing the circuit, and the same action will take place again. A light of this kind is also self-feeding, because, as the carbons burn away, the current again tends to fall, thus diminishing the force of the solenoids and allowing the upper carbon to approach the lower one. The clutch shown is used to permit flexibility of the unit. The ballast coil is to prevent surges in the circuit when the arc is struck. The resistance of the arc decreases as it gets hotter and the ballast resistance takes care of this factor, as its resistance increases with heat, due to increase of current.

BURGLAR ALARM

(1983) Q. 1. Joe Cleveland, Peru, Kansas, asks for some details for the construction of a burglar alarm to be placed around a garden so as to prevent the depredations that are now common in his location.

A. 1. A burglar alarm for a garden is a rather difficult undertaking to install. It is best, because it is most feasible, to string two or three complete turns of No. 36 enameled wire around the border of the garden, supported two inches above the ground, and intertwined with the grass, so that it will not be seen. The ends of the wire are connected in series with a couple of gravity cells, which are in series with the primary of a sensitive relay such as a telephone relay. When the intruder unconsciously breaks the circuit, the relay closes and completes a local bell system, which of course will notify you of the presence of the intruder.

COLLOIDS

(1984) Q. 1. R. S. Adams, Pasadena, Calif., mentions an article appearing in the August, 1925, issue of this magazine regarding colloids. He says that the statements made therein do not coincide with the experience that he has had with river water. He says that he found it quite possible to either filter or settle out the mud in river water. He also says that milk aids in settling river water. He asks: Does this prove that river water is not colloidal or that my experience has been an exception to the rule?

A. 1. We have referred your letter to Mr. Raymond B. Wailes, the author of the article and give his answer below.

"I have your letter relative to the experience which you have had with muddy river water and which were borne to mind by my article, "Colloids" in a recent issue of SCIENCE AND INVENTION.

"You are quite right in your statements and there are explainable facts which could cause the happenings related by you in your letter.

"Relative to the river water which you encountered and which was muddy and from which the solid material was settled out, I would say that the water was not strictly colloidal, but that the mud was in suspension. Now, here is where the trouble comes in. The particles in the suspension can become so fine that they will then be colloidal. Just where the boundary exists is hard to tell. In all probabilities the water which you allowed to settle was a suspension. Therefore, the fact should be realized that all muddy water is not colloidal, but all colloidal water is 'muddy.'

"As to your adding milk to the water to cause it to settle, you are right in accepting my stated fact that electrolytes will dispel colloidal fluids. That is just what your milk did, for it is an electrolyte. This can be proved by placing several drops in series with a lamp and a source of current. The lamp will light.

"Again, salt, being an electrolyte, will settle out colloidal water. This is the cause of deltas. The Mississippi and the Ganges deltas are examples of this. The colloidal water meets salt water with the result that the colloidal particles are dropped."

EARTH SEEN FROM THE AIR

(1985) Q. 1. M. R. Cavanah, St. Louis, Mo., asks: If there were people living on the moon or on the planets, would the earth appear luminous to them, and if so, what is the substance that would reflect the sun's light so that it could be seen at such a great distance?

A. 1. The earth would undoubtedly appear luminous to denizens of the moon because of the light provided by the sun that would be reflected from the surface of the earth.

A substance does not have to be "reflecting" in the usual sense of the word in order to appear luminous. Just to prove this, consider a body that would not ordinarily be assumed to have reflecting properties and place it in a dark room. Direct a beam of light upon it and it will become visible because of the light reflected from its surface to the eye of the observer. This is what happens in the case of the luminous heavenly bodies.

ULTRA-VIOLET RAYS

(1986) Q. 1. Clayton Smith, Flushing, L. I., asks: What substances other than quartz will allow ultra-violet light to pass through?

A. 1. Air and a good many of the gases will allow this to take place, but we cannot name any available solid material that will do so. However, there is a glass manufacturing company that makes certain types of glass that will pass ultra-violet rays and we will furnish the name and address of this company upon receipt of a stamped addressed envelope.

Q. 2. What substances can be penetrated by sub-red rays?

A. 2. Sub-red rays are virtually heat rays. Glass and all transparent and many opaque substances are penetrable by sub-red rays. When you feel the heat from an open fire or from an incandescent heater on your body it means that the infra-red rays from that source are passing through your clothes to some extent. Try an experiment similar to this by placing a piece of opaque paper between your hand and the source.

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8. Underwriters Lab.
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10. Dartmouth College
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12. Lehigh University
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Call Letters	Location and Name	Power & Wave Length
KDKA	East Pittsburgh, Pa., Westinghouse Electric & Mfg. Co.	Variable—309.1
KDLR	Devils Lake, N. D., Radio Electric Co. & Wilson Insurance Agency	5—231
KDPM	Cleveland, Ohio, Westinghouse Electric & Mfg. Co.	500—250
KDYL	Salt Lake City, Utah, Newhouse Hotel	50—246
KDZB	Bakersfield, Calif., Frank E. Siefert	100—209.7
KFAB	Lincoln, Neb., Nebraska Buick Auto Co.	1000—340.7
KFAD	Phoenix, Ariz., McArthur Bros. Mercantile Co.	100—273
KFAF	San Jose, Calif., Montgomery Hotel	50—217.3
KFAJ	Boulder, Colo., University of Colorado	100—261
KFAU	Boise, Idaho, Boise High School	500—278
KFAW	Santa Ana, Calif., The Radio Den	10—214.2
KFBB	Havre, Mont., F. A. Buttrey & Co.	50—275
KFBC	San Diego, Calif., W. K. Azbill	10—224
KFBG	Tacoma, Wash., First Presbyterian Church	50—250
KFBK	Sacramento, Calif., Kimball-Upson Co.	100—248
KFBL	Everett, Wash., Leese Bros.	100 —224
KFBS	Trinidad, Colo., School District No. 1	15—238
KFBU	Laramie, Wyo., The Cathedral (Bishop N. S. Thomas)	50—270
KFCB	Phoenix, Ariz., Nielson Radio Supply Co.	100—238
KFCF	Walla Walla, Wash., Frank A. Moore	100—256
KFDD	Boise, Idaho, St. Michaels Cathedral	50—278
KFDH	Tucson, Ariz., University of Arizona	50—258
KFDJ	Corvallis, Ore., Oregon Agricultural College	500—254
KFDM	Beaumont, Tex., Magnolia Petroleum Co.	500—315.6
KFDX	Shreveport, La., First Baptist Church	100—250
KFDY	Brookings, S. Dak., South Dakota State College of Agriculture and Mechanic Arts	100—273
KFDZ	Minneapolis, Minn., Harry O. Iverson	10—231
KFEC	Portland, Ore., Meier & Frank Co.	50—248
KFEL	Denver, Colo., Winner Radio Corp.	50—254
KFEQ	Oak, Nebr., Scroggin & Co. Bank	500—268
KFEY	Kellogg, Idaho, Bunker Hill & Sullivan Mining & Concentrating Co.	10—233
KFFP	Moberly, Mo., First Baptist Church	50—242
KFFV	Lamoni, Iowa, Graceland College	100—250
KFFY	Alexandria, La., Louisiana College	50—275
KFGC	Baton Rouge, La., Louisiana State University	100—268
KFGH	Stanford University, Calif., Leland Stanford Junior University	500—270
KFGQ	Boone, Iowa, Crary Hardware Co.	10—226
KFGX	Orange, Tex., First Presbyterian Church	500—250
KFHA	Gunnison, Colo., Western State College of Colorado	50—252
KFHL	Oskaloosa, Iowa, Penn College	10—240
KFI	Los Angeles, Calif., Earle C. Anthony (Inc.)	3000—468.5
KFIF	Portland, Ore., Benson Polytechnic Institute	100—248
KFIO	Spokane, Wash., North Central High School	100—266
KFIQ	Yakima, Wash., First Methodist Church	100—256
KFIU	Juneau, Alaska, Alaska Electric Light & Power Co.	10—226
KFIZ	Fond du Lac, Wis., Daily Commonwealth and Wisconsin Radio Sales, Inc.	100—273
KFJB	Marshalltown, Iowa, Marshall Electric Co.	10—248
KFJC	Junction City, Kansas, Episcopal Church (R. B. Fegan)	10—218.8
KFJF	Oklahoma, Okla., National Radio Mfg. Co.	225—261
KFJI	Astoria, Ore., Liberty Theatre	10—246
KFJM	Grand Forks, N. Dak., University of North Dakota	100—278
KFJR	Portland, Oregon, Ashley C. Dixon & Son	50—263
KFJX	Cedar Falls, Iowa, Iowa State Teachers' College	50—258
KFJY	Fort Dodge, Iowa, Tunwall Radio Co.	50—246
KFJZ	Fort Worth, Tex., South-Western Baptist Theological Seminary	50—254
KFKA	Greeley, Colo., Colorado State Teachers' College	50—273
KFKQ	Conway, Ark., Conway Radio Laboratories	100—250
KFKU	Lawrence, Kans., University of Kansas	500—275
KFKX	Hastings, Nebr., Westinghouse Electric & Mfg. Co.	2000—288.3
KFKZ	Kirksville, Mo., F. M. Henry	5—266
KFLR	Albuquerque, N. Mex., University of New Mexico	100—254
KFLU	San Benito, Tex., San Benito Radio Club	10—236
KFLV	Rockford, Ill., Swedish Evangelical Mission Church	100—229
KFLX	Galveston, Tex., George R. Clough	10—240
KFLZ	Atlantic, Iowa, Atlantic Automobile Co.	100—273
KFMQ	Fayetteville, Ark., University of Arkansas	750—299.8
KFMR	Sioux City, Iowa, Morningside College	100—261
KFMW	Houghton, Mich., M. G. Sateren	50—263
KFMX	Northfield, Minn., Carleton College	500—336.9
KFNF	Shenandoah, Iowa, Henry Field Seed Co.	500—266
KFOA	Seattle, Wash., Rhodes Dept. Store	500—454.3
KFOB	Burlingame, Calif., Burlingame Chamber of Commerce (Albert Sherman)	50—226
KFOJ	Moberly, Mo., Moberly High School	10—242
KFON	Long Beach, Calif., Echophone Radio Shop	100—233
KFOO	Salt Lake City, Utah, Latter Day Saints University	250—236
KFOR	David City, Nebr., David City Tire & Electric Co.	100—226
KFOT	Wichita, Kans., College Hill Radio Club (College Hill Methodist Church)	50—231
KFOX	Omaha, Nebr., Technical High School	100—248
KFOY	St. Paul, Minn., Beacon Radio Service	50—252
KFPG	Los Angeles, Calif., K. M. Turner Radio Corp. (Oliver S. Garretson)	500—238
KFPL	Dublin, Texas, C. C. Baxter	15—252
KFPM	Greenville, Texas, New Furniture Co.	10—242
KFPR	Los Angeles, Calif., Los Angeles County Forestry Department	500—231
KFPW	Carterville, Mo., St. Johns Church	20—258
KFPY	Spokane, Wash., Symons Investment Co.	100—266
KFQA	St. Louis, Mo., The Principia	50—261
KFQB	Fort Worth, Texas, Searchlight Publishing Co.	150—263
KFQC	Taft, Calif., Kidd Brothers Radio Shop	100—231
KFQP	Iowa City, Iowa, George S. Carson, Jr.	10—224
KFQT	Denison, Texas, Texas National Guard, 36th Signal Company	10—252
KFQU	Holy City, Calif., W. E. Riker	100—217.3
KFQW	North Bend, Wash., C. F. Knierim	50—215.7
KFQZ	Hollywood, Calif., Taft Radio Co.	50—226
KFRB	Beeville, Tex., Hall Brothers	250—248
KFRC	San Francisco, Calif., City of Paris Dry Goods Co.	50—268
KFRM	Fort Sill, Okla., Lieut. James P. Boland, U. S. A.	50—242
KFRU	Columbia, Mo., Stephens College	500—499.7
KFRW	Olympia, Wash., United Churches of Olympia	50—218.8
KFRX	Pullman, Wash., J. Gordan Klemgard	10—217.3
KFRY	State College, N. Mex., New Mexico College of Agriculture and Mechanic Arts	50—266

(*Continued on page* 850)

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Broadcast Calls

(*Continued from page* 848)

Call Letters	Name	Location	Power & Wave Length
KFRZ	Hartington, Neb., Electric Shop (P. M. Thies)		15—222
KFSG	Los Angeles, Calif., Echo Park Evangelistic Assn.		500—275
KFUJ	Breckenridge, Minn., Hoppert Plumbing & Heating Co. and F. H. Rettig		50—242
KFUL	Galveston, Tex., Thomas Goggan & Bros. Music Co.		50—258
KFUM	Colorado Springs, Colo., W. D. Corley		100—242
KFUO	St. Louis, Mo., Concordia Seminary		500—545.1
KFUP	Denver, Colo., Fitzsimons General Hospital		50—234
KFUR	Ogden, Utah, Peery Building Co.		50—224
KFUS	Oakland, Calif., Louis L. Sherman		50—256
KFUT	Salt Lake City, Utah, University of Utah		100—261
KFUU	San Leandro, Calif., Colburn Radio Labs.		50—224
KFUV	Springfield, Mo., G. Pearson Ward		10—252
KFVD	San Pedro, Calif., McWhinnie Electric Co.		50—205.4
KFVE	St. Louis, Mo., Film Corporation of America		500—240
KFVG	Independence, Kansas, First Methodist Epis. Church		10—236
KFVH	Manhattan, Kansas, Whan Radio Shop		15—218.8
KFVI	Houston, Texas, Fifty-sixth Brigade, Headquarters Troop		10—240
KFVN	Welcome, Minn., Carl E. Bagley		10—227
KFVR	Denver, Colo., (near) Moonlight Ranch, Route 6, Eugene Rossi		50—244
KFVS	Cape Girardeau, Mo., Cape Girardeau Battery Station, Oscar C. Hirsch		50—224
KFVU	Eureka, Calif., Radio Shop, Standard Publishing Co.		5—209.7
KFVW	San Diego, Calif., Airfan Radio Corp.		500—246
KFVX	Bentonville, Ark., Radio Shop, R. H. Porter		10—236
KFVY	Albuquerque, N. Mex., Radio Supply Co.		10—250
KFWA	Ogden, Utah, Browing Bros. Co.		100—261
KFWB	Hollywood, Calif., Warner Bros. Pictures (Inc.)		500—252
KFWC	Upland, Calif., L. E. Wall		50—211.1
KFWD	Arkadelphia, Arkansas, Arkansas Light & Power Co.		500—266
KFWF	St. Louis, Mo., St. Louis Truth Center		250—214.2
KFWH	Chico, Calif., F. Wellington Morse, Jr.		100—254
KFWI	South San Francisco, Calif., Radio Entertainments (Inc.)		500—226
KFWM	Oakland, Calif., Oakland Education Society		500—206.8
KFWO	Avalon, Calif., Lawrence Mott		250—211.1
KFWP	Brownsville, Tex., Rio Grande Radio Supply House		10—214.2
KFWU	Pineville, La., Louisiana College		100—238
KFWV	Portland, Ore., Wilbur Jerman		50—212.6
KFXB	Big Bear Lake, Calif., Bertram O. Heller		500—202.6
KFXC	Santa Maria, Calif., Santa Maria Valley R. R. Co.		100—209.7
KFXD	Logan, Utah, L. H. Strong (Packard Motor Co.)		10—205.4
KFXE	Waterloo, Iowa. Electrical Research & Mfg.		10—236
KFXF	Colorado Springs, Colo., Pikes Peak Broadcasting Co.		500—250
KFXH	El Paso, Texas, Bledsoe Radio Co.		50—242
KFXJ	Denver, Colo., Mountain States Radio Distributors, Inc. (Portable)		10—215.7
KFXM	Beaumont, Texas, Neches Electric Co.		10—227
KFXY	Flagstaff, Ariz. (Orpheum Theatre), Mary M. Costigan		50—205.4
KFYF	Oxnard, Calif., Carl's Radio Den (Newcomb Radio Co.)		10—205.4
KFYJ	Houston, Tex., Houston Chronicle Publishing Co. (Portable)		10—238
KGB	Tacoma, Wash., Tacoma Daily Ledger		100—250
KGO	Oakland, Calif., General Electric Co.		3000—361.2
KGTT	San Francisco, Calif., Glad Tidings Tabernacle		50—234
KGU	Honolulu, Hawaii, Marion A. Mulrony		500—270
KGW	Portland, Ore., Portland Morning Oregonian		500—491.5
KGY	Lacey, Wash., St. Martins College		5—246
KHJ	Los Angeles, Calif., Times-Mirror Co.		500—405.2
KHQ	Spokane, Wash, Louis Wasmer		500—273
KJBS	San Francisco, Calif., Julius Brunton & Sons Co.		5—220
KJR	Seattle, Wash., Northwest Radio Service Co.		1000—384.4
KLDS	Independence, Mo., Reorganized Church of Jesus Christ of Latter Day Saints		1000—440.9
KLS	Oakland, Calif., Warner Bros. Radio Supplies Co.		250—252
KLX	Oakland, Calif., Tribune Publishing Co.		500—508.2
KLZ	Denver, Colo., Reynolds Radio Co.		250—266
KMA	Shenandoah, Iowa, May Seed & Nursery Co.		500—252
KMJ	Fresno, Calif., Fresno Bee		50—234
KMO	Tacoma, Wash., Love Electric Co.		100—250
KNRC	Los Angeles, Calif., Clarence B. Juneau		250—208.2
KNX	Los Angeles, Calif., Los Angeles Evening Express		500—336.9
KOA	Denver, Colo., General Electric Co.		5000—322.4
KOB	State College, N. M., New Mexico College of Agriculture and Mechanic Arts.		1000—348.6
KOCH	Omaha, Neb., Omaha Central High School		250—258
KOCW	Chickasha, Okla., Oklahoma College for Women		200—21[illegible]
KOIL	Council Bluffs, Iowa, Monarch Mfg. C.		500—278
KOP	Detroit, Mich., Detroit Police Department		500—278
KPO	San Francisco, Calif., Hale Bros.		1000—428.3
KPPC	Pasadena, Calif., Pasadena Presbyterian Church		50—229
KPRC	Houston, Texas, Post Dispatch		500—296.9
KPSN	Pasadena, Calif., Pasadena Star News		1000—315.6
KQP	Portland, Ore., H. B. Read.		500—212.6
KQV	Pittsburgh, Pa., Doubleday-Hill Electric Co.		500—275
KQW	San Jose, Calif., Charles D. Herrold		500—231
KRE	Berkeley, Calif., Berkeley Daily Gazette		100—256
KSAC	Manhattan, Kans., Kansas State Agricultural College		500—340.7
KSD	St. Louis, Mo., Post Dispatch		750—545.1
KSL	Salt Lake City, Utah, Radio Service Corp. of Utah		1000—299.8
KSO	Clarinda, Iowa, A. A. Berry Seed Co.		500—242
KTAB	Oakland, Calif., Tenth Avenue Baptist Church		1000—240
KTBI	Los Angeles, Calif., Bible Inst. of Los Angeles		750—293.9
KTBR	Portland, Ore., Brown's Radio Shop		50—263
KTCL	Seattle, Wash., American Radio Telephone Co.		1000—305.9
KTHS	Hot Springs, Ark., New Arlington Hotel Co.		500—374.8
KTNT	Muscatine, Iowa, Norman Baker		500—256
KTW	Seattle, Wash., First Presbyterian Church		1000—454.3
KUO	San Francisco, Calif., Examiner Printing Co.		150—250
KUOM	Missoula, Mont., University of Montana		250—244
KUSD	Vermillion, S. D., University of South Dakota		100—278
KUT	Austin, Texas, University of Texas		500—231
KVOO	Bristow, Okla., Voice of Oklahoma		500—374.8
KWUC	Le Mars, Iowa, Western Union College		50—252
KWG	Stockton, Calif., Portable Wireless Telephone Co.		50—248
KWKC	Kansas City, Mo., Wilson Duncan Studios		100—236
KWKH	Kennonwood, La., W. G. Patterson		500—261
KWSC	Pullman, Wash., State College of Washington		500—348.6
KWWG	Brownsville, Texas, City of Brownsville, Board of City Development		500—278

(*Continued on page* 852)

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Your Attention, Please — Special Offer

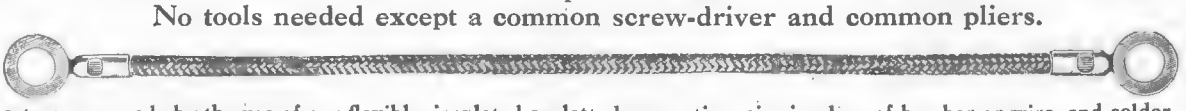
To get you started dealing with us, we offer special prices on these most popular two kits. But your order will have to be sent by January 31 when our regular catalog prices will again be in effect.

Your chance to get the best kit at a *big saving! Take it!*

All of our Kits contain complete parts for receiver, including drilled and engraved Bakelite-Dilecto panel, finest, roomy mahogany finish cabinet, simple new-style blueprint and instructions, everything—nothing more to buy. All parts highest grade—advertised, well-known, reliable, dependable—fully guaranteed by manufacturers and ourselves. Look at these brands. You cannot get better kits!

Our New Method of Wiring—Perfectly Simple—No Radio Knowledge Needed

No solder—No bare wires—No poor connections—No dissatisfaction.
No tools needed except a common screw-driver and common pliers.



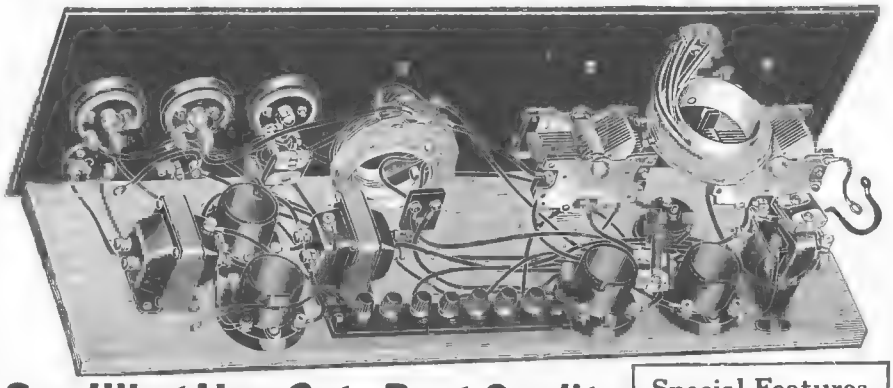
All connections are made by the use of our flexible, insulated eyeletted connecting wire in place of bus bar or wire, and solder. And in a fraction of the time usually required when using the old fashioned way. And when the job is done it is neat and your connections are tight.

4-Tube Roberts Knock-Out

Superior to most other sets REGARDLESS OF NUMBER OF TUBES!

Spl. $43.59 *Postpaid* Kit JK, 9215 Range 3500 Miles

Combines principles of Reflex, Neutralization, Tuned Radio Frequency, Regeneration (without blooping), and Push-Pull Amplification. Smooth-working—easily tuned—non-howling—non-squealing—non-radiative. Guaranteed absolutely to give entire satisfaction.



See what Doubleday, Page & Co., through Mr. Arthur H. Lynch, Editor of their magazine, "Radio Broadcast," say about the Radio Broadcast's sensational 4-Tube Knock-Out Set developed by Walter Van B. Roberts:

"Tube for tube, dollar for dollar, result for result, we will stack it up against any receiver for home construction ever described by any radio publication and gamble that it comes out winner."

MR. LYNCH ADDS—READ IT!

"It is the best we have ever seen—and we have seen and operated almost every type made and used during the past twelve years. It has pulled in forty-six stations on a loud speaker with two tubes, using an indoor antenna. Its signals have been heard through the air more than a quarter mile. It is not merely the best four-tube receiver, but the best by a very good margin."

CUSTOMERS PRAISE IT!

Receives Calif. from N. Y. on Two Tubes!

"I have followed the development of the Roberts circuit with results far beyond all expectations. I find it to be EXACTLY as efficient as described, although I was skeptical as to the unusual operation that it was said to have accomplished. I no longer have any doubts, for in the last week of August and to date in September, I have received KGO at least four times. On one of these occasions I received it on my Dictograd loud speaker, using only two tubes! I have consistently received long distance, such as Dallas, Fort Worth, Auburn, La., Hastings, and Kansas City, in all about 65 stations, while just "fishing." Locals, such as Pittsburgh, Schenectady, New York City, Chicago, Boston, etc., it need not be mentioned, are perfect, even on occasions when I have used neither aerial nor ground. I am sure it was a lucky day when this set came to my attention." L. L. Clifford, 190 Second Street, Fulton, NEW YORK.

Selectivity Better than Eight tube Heterodyne

"Last week I constructed the four-tube Roberts Knock-Out set. I am more than pleased by its operation, its selectivity being better than my eight-tube super-heterodyne. On a poor night I was able to bring in WOS, WGN, WOC, WSAI, WBZ, and all at loud speaker intensity." Louis R. Jeffrey, 51 Newark Street, Hoboken, NEW JERSEY.

See What You Get—Best Quality

Fine 7x24x8 mahogany finish cabinet, drilled and engraved **Bakelite-Dilecto** panel, extra good, non-warping baseboard, **Sickles' Roberts'** coils, 2 **Hammarlund** low loss variable condensers, 3 **E-Z Toon** vernier dials, **Thordarson** transformer, pair **Modern** push-pull transformers, 3 **Pacent** rheostats, 4 **Bell Bakelite** low loss sockets, **Improved** single-circuit jack, **Improved** double-circuit jack, **Cutler-Hammer** inductance switch, **Smilear** filament switch, **Pacent** grid leak, **Hilco** grid condenser and mounting, 2 **Hilco** fixed condensers, **Amplex** grid-denser, 7 **Aristocrat** binding posts, binding post strip, complete set **"No-Sod-er"** connecting wires, hardware, blueprint and instruction sheet. You can assemble in only three hours or so.

List price, $64.69; our regular catalog price, $48.56—Special price to January 31, only $43.59.

Special Features

Great volume.
Utmost clearness.
Sweetness of tone.
Highly selective.
Cheap to build.
Easy to operate.
Receives great distance.
Does not radiate or cause squealing in your neighbors' receivers.
Low cost of upkeep.
It offers a better combination of sensitivity, selectivity and quality for the total cost than any other circuit we have ever known.
The best 4-Tube set for home construction ever produced.

3-Tube LoLos Explorer—Spl. $26.59

Postpaid—Kit JK6996 Range 1000 Miles on Loud Speaker

Stations Logged in 2 hours at New York City

All on Loud Speaker

By one of the editors of "Radio News"

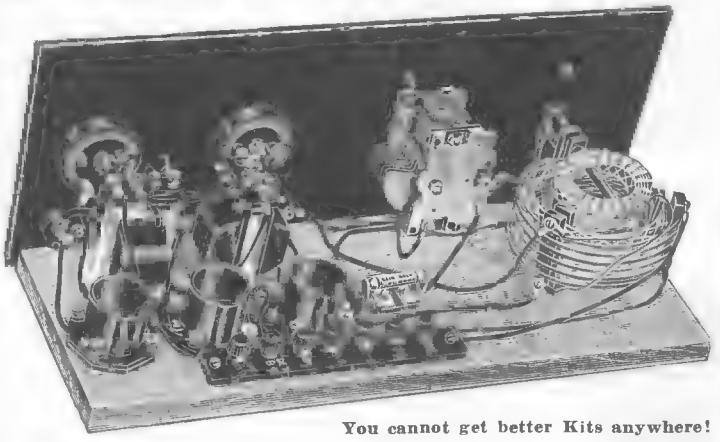
WJZ	72	65	N. Y. City
WEAF	86	77	N. Y. City
WFBH	65	21	N. Y. City
WFAM	55	18	St. Cloud, Minn.
WQAO	73	40	N. Y. City
WEBH	75	43	Chicago
WJY	72	52	N. Y. City
KDKA	70	32	E. Pittsburgh, Pa.
WTAS	67	25	Elgin, Ill.
WGBS	67	30	N. Y. City
WHN	72	39	N. Y. City
WJAX	88	48	Cleveland
WIT	75	83	Philadelphia, Pa.
KYW	78	93	Chicago
WOC	83	74	Davenport, Iowa

This is a dandy! Order it!

Positively a "hummer!" We have never tested an outfit at anywhere near our price more suitable for long distance broadcast reception. Contains a low loss 3-circuit tuner, a low loss condenser, low loss sockets, etc. Special Features: Sensitive—Selective—Clear reception—Simple to construct—Simple to operate—Dependable—Low loss design—Receives long distances—Great volume.

We Give You High-Class Parts

Fine 7x18x8 mahogany finish cabinet, drilled and engraved Bakelite-Dilecto panel, extra good, non-warping baseboard, Gen-Win low loss coupler, Hammarlund low loss variable condenser, 2 Bell Bakelite dials, 2 Rasco verniers, 2 Pacent A. F. transformers, 2 Pacent rheostats, 3 Bell Bakelite low loss sockets, Improved single circuit jack, 2 Improved double circuit jacks, Smilear A battery filament switch, Hilco fixed grid condenser and mounting, Pacent grid leak, 7 Aristocrat moulded binding posts, binding post strip, complete set "No-Sod-er" connecting wires, hardware, blueprint and instruction sheet. You can assemble in only a couple of hours. List price for parts, $37.84. Our catalog price, $30.25. Special Price to January 31st, only $26.59.



You cannot get better Kits anywhere!

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Mr. Koller has had twenty years' teaching experience, and his success in helping other men and women is an indication of what he can do for you.

H. L. Wood, a clerk, made more than $700 "on the side" before he had completed his course and also won $125 in prizes. Harry William Lord writes that he has more than doubled his salary as a result of studying this I. C. S. course in spare time. William Whitman, a former wagon builder, now has a sign painting business of his own and is earning *nearly three times* as much as he did before enrolling with the International Correspondence Schools.

There is no doubt that Show Card Lettering and Sign Lettering offer a real opportunity to ambitious men and women. Just mark and mail the coupon and we'll gladly send you a booklet telling all about the I. C. S. course in Show Card Lettering, or any other subject in which you are interested.

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☐ Salesmanship
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TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineering
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☐ Machine Shop Practice
☐ Railroad Positions
☐ Gas Engine Operating
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☐ Steam Engineering ☐ Radio
☐ Architect
☐ Architects' Blueprints
☐ Contractor and Builder
☐ Architectural Draftsman
☐ Concrete Builder
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Adds—Subtracts—Multiplies—Divides
Does work of $300 machine. Guaranteed 5 years. NOT A TOY.
Made of steel and indestructible. Million dollar capacity. Fits in pocket. Will not make mistakes. So simple child can operate it. Everybody should carry one for figuring.

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Insure your copy reaching you each month. Subscribe to SCIENCE & INVENTION—$2.50 a Experimenter Publishing Co., 53 Park Pl., N. Y. C.

Broadcast Calls

(*Continued from page 850*)

Call Letters	Name	Location	Power & Wave Length
KYW	Chicago, Ill., Westinghouse Electric & Mfg. Co.		2000—535.4
KZKZ	Manila, P. I., Electrical Supply Co.		100—270
KZM	Oakland, Calif., Preston D. Allen		100—240
KZRQ	Manila, P. I., Manila Hotel, Far Eastern Radio (Inc.)		500—222
KZUY	Baguio, P. I., F. Johnson Elser		500—360
WAAB	New Orleans, La., Valdemar Jenson		100—268
WAAC	New Orleans, La., Tulane University		100—275
WAAD	Cincinnati, Ohio, Ohio Mechanics Institute		25—258
WAAF	Chicago, Ill., Chicago Daily Drovers Journal		200—278
WAAM	Newark, N. J., I. R. Nelson Co.		500—263
WAAW	Omaha, Neb., Omaha Grain Exchange		500—278
WABB	Harrisburg, Pa., Harrisburg Sporting Goods Co.		10—266
WABC	Asheville, N. C., Asheville Battery Co.		20—254
WABI	Bangor, Me., First Universalist Church		100—240
WABO	Rochester, N. Y., Lake Avenue Baptist Church		100—278
WABQ	Haverford, Pa., Haverford College Radio Club		100—261
WABR	Toledo, Ohio, Scott High School		50—263
WABW	Wooster, Ohio, College of Wooster		50—206.8
WABX	Mount Clemens, Mich. (near), Henry B. Joy		500—246
WABY	Philadelphia, Pa., John Magaldi, Jr.		50—242
WABZ	New Orleans, La., Coliseum Place Baptist Church		50—275
WADC	Akron, Ohio, Allen Theatre		500—258
WAFD	Port Huron, Mich., Albert B. Parfet Co.		500—275
WAGM	Royal Oak, Mich., Robert L. Miller		50—258.6
WAHG	Richmond Hill, N. Y., A. H. Grebe & Co.		500—315.6
WAIT	Taunton, Mass., A. H. Wait & Co.		10—229
WAIU	Columbus, Ohio, American Insurance Union		500—293.9
WAMD	Minneapolis, Minn., Hubbard & Co.		500—244
WAPI	Auburn, Ala., Alabama Polytechnic Inst.		500—248
WARC	Medford Hillside, Mass., American Radio Research Corp.		100—261
WBAA	West Lafayette, Ind., Purdue University		250—273
WBAK	Harrisburg, Pa., Pa. State Police		500—275
WBAO	Decatur, Ill., James Millikin University		100—270
WBAP	Fort Worth, Texas, Wortham-Carter Publishing Co. (Star-Telegram)		1500—475.9
WBAV	Columbus, Ohio, Erner & Hopkins Co.		500—293.9
WBAX	Wilkes-Barre, Pa., John H. Stenger, Jr.		100—256
WBBA	Newark, Ohio, Plymouth Congregational Church		20—226
WBBL	Richmond, Va., Grace Covenant Church		150—229
WBBM	Chicago, Ill., Atlas Investment Co.		1500—226
WBBP	Petoskey, Mich., Petoskey High School		200—238
WBBR	Rossville, N. Y., Peoples Pulpit Assn.		500—273
WBBS	New Orleans, La., First Baptist Church		50—252
WBBU	Monmouth, Ill., Jenks Motor Sales Co.		10—224
WBBW	Norfolk, Va., Ruffner Junior High School		50—222
WBBY	Charleston, S. C., Washington Light Infantry		10—268
WBBZ	Chicago, Ill. (Portable), C. L. Carrell		50—215.7
WBCN	Chicago, Ill., Foster & McDonnell		500—266
WBDC	Grand Rapids, Mich., Baxter Laundry Co.		50—256
WBES	Tacoma Park, Md., Bliss Electrical School		100—222
WBNY	New York, N. Y., Shirley Katz		500—209.7
WBOQ	Richmond Hill, N. Y., A. H. Grebe & Co.		100—236
WBRC	Birmingham, Ala., Bell Radio Corporation		10—248
WBRE	Wilkes Barre, Pa., Baltimore Radio Exchange		100—231
WBT	Charlotte, N. C., Charlotte Chamber of Commerce		250—275
WBZ	Springfield, Mass., Westinghouse Electric & Mfg. Co.		2000—331.1
WBZA	Boston, Mass., Westinghouse Elec. & Mfg. Co.		250—242
WCAC	Mansfield, Conn., Connecticut Agricultural College		500—275
WCAD	Canton, N. Y., St. Lawrence University		250—263
WCAE	Pittsburgh, Pa., Kaufmann & Baer Co.		500—461.3
WCAH	Columbus, Ohio, Entrekin Electric Co.		500—266
WCAJ	University Place, Neb., Nebraska Wesleyan University		500—254
WCAL	Northfield, Minn., St. Olaf College		500—336.9
WCAO	Baltimore, Md., Albert A. and A. Stanley Brazer		100—275
WCAP	Washington, D. C., Chesapeake & Potomac Telephone Co.		500—468.5
WCAR	San Antonio, Texas, Southern Radio Corporation of Texas		500—263
WCAT	Rapid City, S. D., South Dakota State School of Mines		50—240
WCAU	Philadelphia, Pa., Universal Broadcasting Co. (Durham & Co.)		500—278
WCAX	Burlington, Vt., University of Vermont		100—250
WCAZ	Carthage, Ill., Carthage College		50—246
WCBA	Allentown, Pa., Queen City Radio Station		15—254
WCBC	Ann Arbor, Mich., University of Michigan		200—229
WCBD	Zion, Ill., Wilbur G. Voliva		5000—344.6
WCBE	New Orleans, La., Uhalt Brothers Radio Co.		5—263
WCBG	Pascagoula, Miss. (portable), Howard S. Williams		10—268
WCBH	Oxford, Miss., University of Mississippi		50—242
WCBM	Baltimore, Md., Hotel Chateau		50—229
WCBQ	Nashville, Tenn., First Baptist Church		100—236
WCBR	Providence, R. I. (portable), Charles H. Messter		30—205.4
WCCO	Minneapolis, Minn., Washburn-Crosby Co.		5000—416.4
WCEE	Elgin, Ill., Liberty Weekly		1000—275
WCLO	Camp Lake, Wis., C. E. Whitmore		50—231
WCLS	Joliet, Ill., H. M. Couch		150—214.2
WCSH	Portland, Me., Congress Square Hotel Co.		500—256
WCSO	Springfield, Ohio, Wittenberg College		100—248
WCUW	Worcester, Mass., Clark University		250—238
WCWS	Providence, R. I., United States (Portable) Chas. W. Selen		100—209.7
WCX	Detroit, Mich., Detroit Free Press		2500—516.9
WDAD	Nashville, Tenn., Dad's Auto Accessories (Inc.)		150—226
WDAE	Tampa, Fla., Tampa Daily Times		250—273
WDAF	Kansas City, Mo., Kansas City Star		500—365.6
WDAG	Amarilla, Texas, J. Laurance Martin		100—263
WDAY	Fargo, N. D., Radio Equipment Corporation		50—261
WDBC	Lancaster, Pa., Kirk, Johnson & Co.		50—258
WDBE	Atlanta, Ga., Gilham-Schoen Electric Co.		100—270
WDBJ	Roanoke, Va., Richardson-Wayland Electrical Corporation		50—229
WDBK	Cleveland, Ohio, M. & F. Broz Furniture, Hardware & Radio Store		100—227
WDBO	Winter Park, Fla., Rollins College		100—240
WDBQ	Salem, N. J., Morton Radio Supply Co.		10—234
WDBR	Boston, Mass., Tremont Temple Baptist Church		100—261
WDBZ	Kingston, N. Y., Boy Scouts of America		10—233
WDCH	Hanover, N. H., Dartmouth College		100—256
WDOD	Chattanooga, Tenn., Chattanooga Radio Co.		50—256
WDRC	New Haven, Conn., Doolittle Radio Corp.		100—268
WDWF	Cranston, R. I., Dutee W. Flint		500—440.9

(*Continued on page 856*)

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The Simplest Practical Radio Set Made

$1.00

The RADIOGEM

The simplest radio outfit made—yet as practical as the most expensive. A crystal receiving set that you can operate and enjoy even though you know absolutely nothing about radio. You receive the RADIOGEM unassembled, together with a clearly written instruction book, which shows you how to quickly and easily construct the set, using only your hands and a scissors. The outfit comprises all the necessary wire, contact points, detector mineral, tube on which to wind the coil, etc., etc. The instruction book explains simply and completely the principles of radio and its graphic illustrations make the assembling of the RADIOGEM real fun.

AERIAL OUTFIT

Complete aerial outfit for the RADIOGEM, consisting of 100 ft. of standard copper aerial wire and two special porcelain insulators. Price .....50c.

Radiogem - - - $1.00
Aerial Outfit - - - - .50
Radiogem and Aerial Outfit - - - - 1.50

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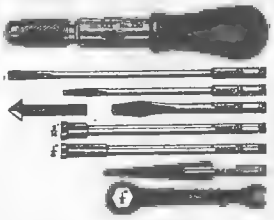
Radio Headquarters for the Finest and BEST Radio Tools

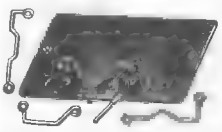


RADIO TOOL SET

This is the handiest set of tools ever made for Radio Work by the makers of the famous "YANKEE" Tools. It contains the following: 1 Rachet Screw-driver, 6½ in. long holding all attachments; 1 Blade, 5½ x 3-16; 1 Blade, 3½ x ⅛; 1 Blade 2½ x ¼; 1 Countersink; 2 Socket Wrenches for all small nuts; 1 Reamer to enlarge holes in panel from ⅛ x ½; 1 Wrench, one end 5-16" square or hex. for jack, other ½" hex., etc.
PRICE per set—No. 701 ..... .$3.00

HAND DRILL

The hardwood handle is hollow to store drills. Iron frame, nickeled parts, ball bearing three jawed chuck holding and centering accurately round shank drills from 0 to 3-16. Length of drill, 12 inches.
PRICE—No. 303 ..... .$2.25



WIRE BENDING TOOL

For making eyes, loops, bends, and offsets on Bus Bar wire. With this device any Radio Constructor can wire his set to compare favorably with any factory made set. Easier to use and more accurate than pliers. Full directions in box. Made of heavy steel, blued and finished.
PRICE—No. 203 .....$1.00

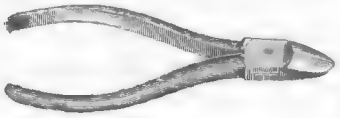
CIRCLE CUTTER

Especially designed for the Radio Constructor. Made of the finest material and equipped with the highest grade high steel cutting bits. It does three things at once. It drills its own pilot, cuts out plug and puts bead or scroll around the hole in one operation. Cuts holes ¾ to 4 in. in diam.
PRICE—No. 402 .....$3.00
401. Same tool but smaller and not fitted with bead or scroll in one operation.
PRICE—No. 401 .....$2.00

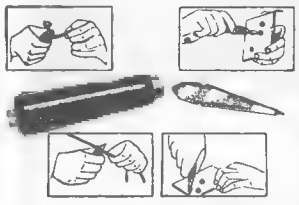
HAND DRILL

Especially designed for Radio Work by the makers of the famous "Yankee" Tools. A beautiful balanced, small, powerful drill with 4 to 1 ratio of gears for speed. Special chuck 0-32" capacity, to take largest drill, mostly furnished with drill or tool sets. Length over all, 9½ in. Weight 1½ lbs.
PRICE—No. 302 .....$2.75

Three-in-One Nut Wrench. Consists of handle with hollow stem 6 inches in length and three interchangeable sockets fitting popular sizes of nuts. The hexagon sockets grip the nut solidly.
PRICE per set—No. 301 .....65c

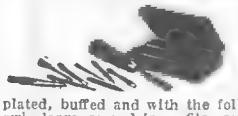


Side Cutting Nipper, Lap Joint. For cutting all kinds of wire. Jaws hardened and oil tempered. Natural steel finish with polished jaws. Length 6 inches.
PRICE—No. 201 .....75c



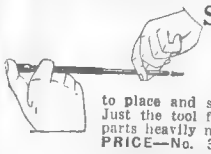
RADIO HANDI-TOOL

Bends Bus Bar or wire strips and scrapes wire, bores and reams holes, etc. Tool consists of 4 in. black japanned handle, to which is attached wire bending device, with nickeled ferrule and 3 in. long two sided reamer.
PRICE—No. 702 .....50c



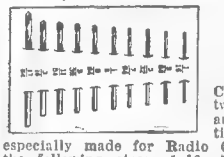
TOOL CHEST

Set consists of "LOCK-GRIP" master handle, 5" long, black Rubberoid finish with steel chuck, nickel plated, buffed and with the following 9 tools: Saw, brad-awl, large screwdriver, file, scratch awl, gimlet, reamer, chisel, small screwdriver. Each tool of fine steel, drop forged tempered, hardened, and nicely finished. Set comes in leatheroid box with tray.
PRICE—No. 703 .....$1.85



SCREW STARTER and DRIVER

Holds any screw by its slot with a firm grip, makes it easy to place and start screws in difficult places. Just the tool for the Radio Constructor. All parts heavily nickeled and polished.
PRICE—No. 304 .....$1.00



RADIO DRILL SET

Composed of 10 straight shank twist drills, fitting all hand and breast drills. The selection of these drills has been especially made for Radio Constructors and consists of the following sizes: 1-16, 5-64, 3-32, 7-64, ⅛, 9-64, 5-32, 11-64, 3-16, 17-64. Drills are mounted on white Holland Linen with sizes clearly marked.
PRICE—No. 305 .....$1.25

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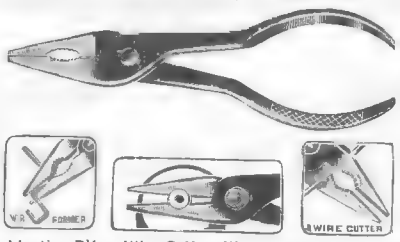
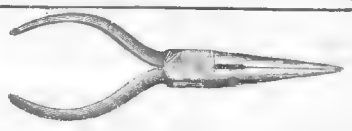
A perfect tool for Radio Work. Operates either on 110-volt A.C. or D.C. The heat element is of Nichrome, which prevents overheating and assures the desired even temperature. Size of Iron, 10½ in. long. A 4-ft. cord and plug is furnished.
PRICE—No. 800 .....$2.00



Combination Plier, Wire Cutter, Wire Former and Wrench. Drop forged, slender but exceptionally strong. 6 in. long.
PRICE—No. 202 .....75c



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Edited By
A. P. PECK

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given. (No questions answered this month, owing to special article.)

Marketing a Patented Invention

By Leo T. Parker

MANY valuable inventions remain unsold during the entire life of the patent, and then become nationally known and extensively used. Obviously the inventors receive no profit from the patents simply because the proper procedure of introducing the articles before the public was not followed, or because the patents were not brought to the attention of the right manufacturers who are always glad to contract to make and sell articles from which they themselves may profit.

The proper method of marketing a patented invention depends somewhat upon the selling price, advantages and kind of an invention it is. We shall first consider the average American inventor who patents an article whose retail selling price is $1.50 to $10.00.

To be exact, there are four distinctly different ways of marketing an invention of this character. The patentee can, with a small investment, contract to have the articles manufactured and sell them himself through the medium of jobbers, retail stores, agents or by mail order, or he may dispose of the patent outright, or he may license one or more firms to manufacture and sell the invention and receive a stipulated amount for each article sold by the licensed firms, or finally he may sell state or territory rights to individuals or firms and license them to manufacture and sell the product within the restricted localities.

The financial condition and experience of the inventor, as well as the character of the invention, have considerable effect as to which of these methods might prove the most profitable and satisfactory. For instance, suppose the invention has possibilities of a large volume of sales, and that the total required investment for having the necessary dies and one thousand of the articles made is $500.00 and let us assume, further, that the inventor is possessed of sufficient finances and has had enough practical experience to enable him to operate a small business efficiently. Then the inventor will make no mistake, if he is a competent salesman —and few inventors are such—in investing the required capital and attempting to sell the jobbing houses direct. To transact business with the class of firms mentioned, a discount of 50 to 60 per cent. off the retail selling price must be offered, and the retail selling must be determined with this necessary discount in view.

As to whether or not the jobbers and large specialty houses can be induced to place an order for a newly patented device depends entirely upon the invention itself. If the invention is radically new and possesses many advantageous points, then the jobbers may be sold without difficulty, but if the invention merely is a slight and not very important improvement over some other old and well known device, no doubt, considerable difficulty will be experienced in obtaining orders from the jobbing trade, particularly for the reason that the older article may already be described in their catalogues. Before jobbers can be induced to invest money in a stock of two similar articles or to discontinue the old product upon which they have an established trade, the new invention necessarily must be possessed of exceptional merit and strikingly noticeable advantages. Otherwise considerable money must be expended by the inventor in advertising the new invention. However, sometimes the retail dealers may be induced to stock a new invention when the jobber will not, and if the orders which are received from the retail dealers are given to the jobbers to fill at the established and prevailing per cent. of profit, the jobbers may be influenced to order an additional stock if they are made to realize that retail dealers are favorably impressed with the invention.

Another highly satisfactory way to introduce an article of this kind is to place agents in the different territories and have them call and sell to the users direct. In this manner the full retail price of the article less an agent's commission can be obtained by the manufacturer. When a large number of agents are in the field, a steady and substantial daily flow of business is among the possibilities. The agents can be sought for by advertising in the "Agents Wanted" columns of the newspapers, or crews of them may be organized and sent from one town or city to another. Agents usually are paid a straight commission or an arrangement of a guaranteed salary and a commission on all sales may be made with those who travel under the supervision of a crew manager who is paid by the patentee. But rarely is it profitable to hire and pay agents a guaranteed salary by mail. As a matter of fact the majority of agents expect only to purchase the goods at a discount and then dispose of them at a fair profit.

If an inventor is not possessed with sufficient finances to introduce the patented article or if for any other reason the manufacture and sale of the invention is not possible, very often it is advisable to obtain a list of various manufacturers throughout the country that already are equipped to make the device. As soon as the patent is issued the inventor can secure as many copies from the Patent Office as are desired at the cost of 10 cents each. He can have a few letter-heads printed and write each manufacturer, enclosing a copy of the patent. If quite a number of letters are to be sent it is advisable to have them multigraphed to effect a good impression and, also, to save the expense of writing each letter individually. The letter should be short and to the point. It may read as follows:

Steko Mfg. Co.,
New York, N. Y.

Gentlemen:

I am enclosing herewith a copy of a United States patent recently issued to me on ———.

This invention is a marked improvement over similar devices now in use, and, no doubt, you will find ready and profitable sales for articles made under its provisions.

I intend to dispose of my invention at an early date either by outright sale or operate with it on a royalty basis with a reasonable cash payment.

Kindly advise me as to the best proposition you have to offer.

Very truly yours,
JOHN DOE.

(To Be Concluded)

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..Youthful Errors	..Weak Eyes	
	..Weak Heart	

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Age..... Occupation.....
Street .....
City..... State.....

Broadcast Calls

(Continued from page 852)

Call Letters	Name	Location	Power & Wave Length
WDZ	Tuscola, Ill., James L. Bush	10 and	100—278
WEAF	New York, N. Y., American Tel. & Tel. Co.		5000—491.5
WEAH	Wichita, Kan., Hotel Lassen Rigby-Gray Hotel Co.).		50—268
WEAI	Ithaca, N. Y., Cornell University		500—254
WEAM	North Plainfield, N. J., Borough of North Plainfield		250—261
WEAN	Providence, R. I., Shepard Co.		500—270
WEAO	Columbus, Ohio, Ohio State University		500—293.9
WEAR	Cleveland, Ohio, Goodyear Tire & Rubber Co.		750—389.4
WEAU	Sioux City, Iowa, Davidson Bros. Co.		100—275
WEAY	Houston, Tex., Iris Theatre		500—270
WEBA	Highland Park, N. J., The Electric Shop		15—233
WEBC	Superior, Wis., Walter C. Bridges		100—242
WEBD	Anderson, Ind., Electrical Equipment & Service Co.		15—246
WEBE	Cambridge, Ohio, Roy W. Waller		10—234
WEBH	Chicago, Ill., Edgewater Beach Hotel Co.		1000—370.2
WEBJ	New York, N. Y., Third Avenue Ry. Co.		500—273
WEBK	Grand Rapids, Mich., Grand Rapids Radio Co.		100—242
WEBL	New York, N. Y., Woolworth Bldg., United States (portable), R. C. A.		100—226
WEBM	New York, N. Y., United States (Portable) Wool-Worth Building		100—226
WEBQ	Harrisburg, Ill., Joseph R. Tate		10—226
WEBR	Buffalo, N. Y., H. H. Howell		50—244
WEBT	Dayton, Ohio, Dayton Cooperative Industrial High School		5—256
WEBW	Beloit, Wis., Beloit College		500—268
WEBZ	Savannah, Ga., Savannah Radio Corp.		5—263
WEEI	Boston, Mass., Edison Electric Illuminating Co. of Boston		500—475.9
WEHS	Evanston, Ill., Evanston Township High School		20—202.6
WEMC	Berrien Springs, Mich., Emmanual Missionary College		500—285.5
WENR	Chicago, Ill., All American Radio Corp.		1000—266
WEW	St. Louis, Mo., St. Louis University		100—248
WFAA	Dallas, Tex., Dallas News & Dallas Journal		500—475.9
WFAM	St. Cloud, Minn., Times Publishing Co.		10—273
WFAV	Lincoln, Nebr., University of Nebraska		500—275
WFBC	Knoxville, Tenn., First Baptist Church		50—250
WFBD	Philadelphia, Pa., Gethsemane Baptist Church		5—234
WFBE	Seymour, Ind., Van de Walle Music and Radio Co.		10—226
WFBG	Altoona, Pa., William F. Gable Co.		100—278
WFBH	New York, N. Y., Hotel Majestic (Concourse Radio Corp.)		500—273
WFBI	Camden, N. J., Galvin Radio Supply Co.		250—236
WFBJ	Collegeville, Minn., St. John's University		50—236
WFBL	Syracuse, N. Y., Onondaga Hotel		100—252
WFBN	Bridgewater, Mass., Radio Sales & Service Co.		10—226
WFBR	Baltimore, Md., Fifth Infantry, Maryland, N. G.		100—254
WFBZ	Galesburg, Ill., Knox College		20—254
WFDF	Flint, Mich., Frank D. Fallian (Police Building)		100—234
WFI	Philadelphia, Pa., Strawbridge & Clothier		500—394.5
WFKB	Chicago, Ill., Francis K. Bridgman		500—217.3
WFRL	Brooklyn, N. Y., Robert M. Lacey and James A. Bergner (Flatbush Radio Laboratories)		100—205.4
WGAL	Lancaster, Pa., Lancaster Electric Supply & Construction Co.		10—248
WGBB	Freeport, N. Y., Harry H. Carman		100—244
WGBC	Memphis, Tenn., First Baptist Church		10—278
WGBF	Evansville, Ind., Finke Furniture Co.		100—236
WGBI	Scranton, Pa., Frank S. Megargee		10—240

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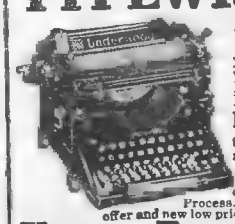

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WGBM	Providence, R. I., Theodore N. Saaty		30—234
WGBQ	Menomonie, Wis., Stout Institute		100—234
WGBR	Marshfield, Wis., George S. Ives		10—229
WGBS	New York, N. Y., Gimbel Brothers		500—315.6
WGBT	Greenville, S. C., Furman University		15—236
WGBU	Miami, Fla., Fulford-by-the-Sea		500—278
WGBW	Spring Valley, Ill., Valley Theater		10—256
WGBX	Orono, Me., University of Maine		100—252
WGCP	Newark, N. J., Grand Central Palace		500—252
WGES	Oak Park, Ill., Coyne Elec. School		500—250
WGHB	Clearwater, Fla., The George H. Bowles Developments		500—266
WGHP	Detroit, Mich., George H. Phelps		1500—270
WGMU	Richmond Hill, N. Y. (portable) A. H. Grebe & Co.		100—236
WGN	Chicago, Ill., The Tribune (Drake Hotel)		1000—370.2
WGR	Buffalo, N. Y., Federal Radio Corp.		750—319
WGST	Atlanta, Ga., Georgia School of Technology		500—270
WGY	Schenectady, N. Y., General Electric Co.		5000—379.5
WHA	Madison, Wisconsin, University of Wisconsin		750—535
WHAD	Milwaukee, Wis., Marquette University and Milwaukee Journal		500—275
WHAG	Cincinnati, Ohio, University of Cincinnati		100—233
WHAM	Rochester, N. Y., University of Rochester (Eastman School of Music)		100—278
WHAP	Brooklyn, N. Y., Wm. H. Taylor Finance Corp.		100—240
WHAR	Atlantic City, N. J., Seaside House Hotel		500—275
WHAS	Louisville, Ky., Courier-Journal & Louisville Times		500—399.8
WHAT	Minneapolis, Minn., George W. Young		500—263
WHAV	Wilmington, Del., Wilmington Electrical Specialty Co.		100—266
WHAZ	Troy, N. Y., Rennselaer Polytechnic Institute		1000—379.5
WHB	Kansas City, Mo., Sweeney School Co.		500—365.6
WHBA	Oil City, Pa., Shaffer Music House		10—250
WHBC	Canton, Ohio, Rev. E. P. Graham		10—254
WHBD	Bellefontaine, Ohio, Chas. W. Howard		20—222
WHBF	Rock Island, Ill., Beardsley Specialty Co.		100—222
WHBG	Harrisburg, Pa., John S. Skane		20—231
WHBH	Culver, Ind., Culver Military Academy		100—222
WHBJ	Fort Wayne, Ind., Lane Auto Co.		50—234
WHBK	Ellsworth, Me., Franklin Street Garage		10—231
WHBL	Logansport, Ind., James H. Slusser		50—215.7
WHBM	Chicago, Ill., C. L. Carrell		20—233
WHBN	St. Petersburg, Fla., First Ave. Methodist Church		10—238
WHBP	Johnstown, Pa., Johnstown Automobile Co.		100—256
WHBQ	Memphis, Tenn., Men's Fellowship Class of St. John's M. E. Church South		50—233
WHBR	Cincinnati, Ohio, Scientific Electric & Mfg. Co.		20—215.7
WHBU	Anderson, Ind., Riviera Theatre and Bings Clothing		10—218.8
WHBW	Philadelphia, Pa., D. R. Kienzle		100—215.7
WHBY	West De Pere, Wis., St. Norbert's College		50—250
WHDI	Minneapolis, Minn., William Hood Dunwoody Industrial Institute		500—278
WHEC	Rochester, N. Y., Hickson Electric Co.		100—258
WHK	Cleveland, Ohio, Radio Air Service Corp. (Warren R. Cox)		250—273
WHN	New York, N. Y., George Schubel		500—361.2
WHO	Des Moines, Iowa, Bankers Life Co.		5000—526
WHT	Deerfield, Ill., Radiophone Broadcasting Corp.		1500—238
WIAD	Ocean City, N. J., Howard R. Miller		100—250
WIAS	Burlington, Iowa, Home Electric Co.		100—254
WIBA	Madison, Wis., Capital Times Studio		100—236

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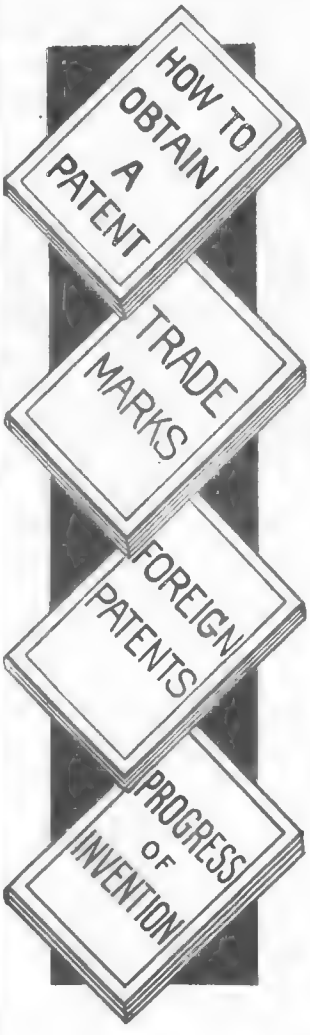

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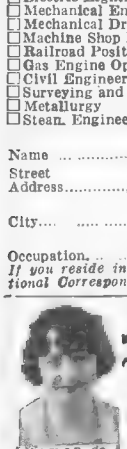

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Call Letters	Location and Name	Power & Wave Length
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WIBH	New Bedford, Mass., Elite Radio Stores, James T. Moriarty	5—209.7
WIBI	Flushing, N. Y., Frederick B. Zittell, Jr.	50—218.8
WIBJ	Chicago, Ill. (Portable), C. L. Carrell	50—215.7
WIBK	Toledo, Ohio, University of the City of Toledo	100—205.4
WIBM	Chicago, Ill. (portable) Billy Maine	10—215.7
WIBO	Chicago, Ill., Nelson Bros., (Russo & Tiorito Orchestra Exchange	1000—226
WIBQ	Farina, Ill., F. M. Schmidt	5—205.4
WIBR	Weirton, W. Va., Thurman A. Owings	50—246
WIBS	Elizabeth, N. J., (portable) N. J. Nat'l. Guard, 57th Infantry Brigade	20—202.6
WIBU	Poynette, Wis., The Electric Farm	20—222
WIBW	Logansport, Ind., L. L. Dill	100—220
WIBX	Utica, N. Y., Grid Leak (Inc.)	5—205.4
WIBV	Henderson, N. C., Jewell Radio Co.	25—263
WIBZ	Montgomery, Ala., Powell Electric Co.	10—231
WIL	St. Louis, Mo., St. Louis Star & Benson Radio Co.	250—273
WIP	Philadelphia, Pa., Gimbel Brothers	500—508.2
WJAD	Waco, Texas, Frank P. Jackson	500—352.7
WJAG	Norfolk, Nebr., Norfolk Daily News	200—270
WJAK	Greentown, Ind., Clifford L. White	100—254
WJAM	Cedar Rapids, Iowa, D. M. Perham	100—268
WJAR	Providence, R. I., The Outlet Co. (J. Samuels & Bro.)	500—305.9
WJAS	Pittsburgh, Pa., Pittsburgh Radio Supply Co.	500—275
WJAZ	Mount Prospect, Ill., Zenith Radio Corp.	1500—322.4
WJBA	Joliet, Ill., D. H. Lentz, Jr.	50—206.8
WJBB	St. Petersburg, Fla., L. W. McClung	10—254
WJBC	La Salle, Ill., Hummer Furniture Co.	100—234
WJBG	Charlotte, N. C., Interstate Radio (Inc.)	10—224
WJBI	Red Bank, N. J., Robert S. Johnson	250—218.8
WJBK	Ypsilanti, Mich., Ernest F. Goodwin	10—233
WJBL	Decatur, Ill., Wm. Gushard, Dry Goods Co.	500—270
WJBN	Sycamore, Ill., St. John's Evangelical Lutheran Church	10—256
WJD	Granville, Ohio, Denison University	10—217.3
WJJD	Mooseheart, Ill., Supreme Lodge, Loyal Order of Moose	500—302.8
WJR	Pontiac, Mich., Jewett Radio & Phonograph Co.	1500—516.9
WJY	New York, N. Y., R. C. A.	1000—405.2
WJZ	New York, N. Y., R. C. A.	1000—454.3
WKAA	Cedar Rapids, Iowa, H. F. Paar	500—278
WKAD	East Providence, R. I., Charles Looff (Crescent Park)	20—240
WKAF	Milwaukee, Wis., WKAF Broadcasting Co.	250—261
WKAP	Cranston, R. I., Dutee W. Flint	50—234
WKAQ	San Juan, P. R., Radio Corp. of America	500—340.7
WKAR	East Lansing, Mich., Michigan State College	1000—285.5
WKAV	Laconia, N. H., Laconia Radio Club (Portable)	50—224
WKBB	Joliet, Ill., Sanders Brothers	100—214.2
WKBE	Webster, Mass., K & B Electric Co.	1000—231
WKBG	Chicago, Ill. (Portable), C. L. Carrell	100—215.7
WKRC	Cincinnati, Ohio, Kodel Radio Corp.	1000—325.9
WKY	Oklahoma, Okla., E. C. Hull and H. S. Richards	100—275
WLAL	Tulsa, Okla., First Christian Church	150—250
WLAP	Louisville, Ky., W. V. Jordan	20—275
WLAX	Greencastle, Ind., Greencastle Community Broadcasting Station	10—231
WLB	Minneapolis, Minn., University of Minnesota	500—278
WLBL	Stevens Point, Wis., Wisconsin Department of Markets	500—278
WLIB	Elgin, Ill. (near), Liberty Weekly	2500—302.8
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WLTS	Chicago, Ill., Lane Technical High School		100—258
WLW	Harrison, Ohio, Crosley Radio Corp.		500 & 5000—422.3
WLWL	New York, N. Y., Missionary Society of St. Paul the Apostle		1000—288.3
WMAC	Cazenovia, N. Y., Clive B. Meredith		100—275
WMAF	Dartmouth, Mass., Round Hills Radio Corp.		1000—440.9
WMAK	Lockport, N. Y., Norton Laboratories		500—266
WMAL	Washington, D. C., M. A. Leese Optical Co.		15—212.6
WMAN	Columbus, Ohio, First Baptist Church		50—278
WMAQ	Chicago, Ill., Chicago Daily News		500—447.5
WMAY	St. Louis, Mo., Kingshighway Presbyterian Church		100—248
WMAZ	Macon, Ga., Mercer University		500—261
WMBB	Chicago, Ill., American Bond & Mortgage Co.		500—250
WMBC	Detroit, Mich., Michigan Broadcasting Co. (F. G. Siegel)		100—256.4
WMBF	Miami Beach, Fla., Fleetwood Hotel Corp.		500—384.4
WMC	Memphis, Tenn., "Commercial Appeal"		500—499.7
WMCA	Hoboken, N. J., Hotel McAlpin (Greeley Square Hotel Co.)		500—340.7
WNAA	Arlington, Va., United States Navy		1000—434.5
WNAB	Boston, Mass., Shepard Stores		100—250
WNAC	Boston, Mass., Shepard Stores		500—280.2
WNAD	Norman, Okla., University of Oklahoma		250—254
WNAL	Omaha, Nebr., Omaha Central High School		50—258
WNAR	Butler, Mo., First Christian Church (C. C. Rhodes)		20—231
WNAT	Philadelphia, Pa., Leuning Brothers Co.		100—250
WNAX	Yankton, S. Dak., Dakota Radio Apparatus Co.		100—244
WNBH	New Bedford, Mass., Irving J. Vermilya and A. J. Lopez		250—248
WNJ	Newark, N. J., Radio Shop of Newark		100—252
WNYC	New York, N. Y., City of New York		1000—526
WOAC	Lima, Ohio, Page Organ Co. (H. P. Maus)		50—261
WOAI	San Antonio, Tex., Southern Equipment Co.		2000—394.5
WOAN	Lawrenceburg, Tenn., James D. Vaughn		500—282.8
WOAW	Omaha, Nebr., Woodmen of the World		1000—526
WOAX	Trenton, N. J., Franklyn J. Wolff		500—240
WOC	Davenport, Iowa, Palmer School of Chiropractic		5000—483.6
WOCG	Sycamore, Ill., Triple Alliance Radio Station		10—205.4
WOCL	Jamestown, N. Y., Hotel Jamestown		15—275
WODA	Paterson, N. J., O'Dea Temple of Music		250—224
WOI	Ames, Iowa, Iowa State College		750—270
WOK	Homewood, Ill., Neutrowound Radio Mfg. Co.		500—217.3
WOKO	New York, N. Y., Otto Baur		50—233
WOO	Philadelphia, Pa., John Wanamaker		500—508.2
WOQ	Kansas City, Mo., Unity School of Christianity		1000—278
WOR	Newark, N. J., L. Bamberger & Co.		500—405.2
WORD	Batavia, Ill., Peoples Pulpit Association		5000—275
WOS	Jefferson City, Mo., Missouri State Marketing Bureau		500—440.9
WOWL	New Orleans, La., Owl Battery Co.		10—270
WOWO	Fort Wayne, Ind., Main Auto Supply Co.		500—227
WPAK	Agricultural College, N. Dak., North Dakota Agricultural College		50—275
WPCC	Chicago, Ill., North Shore Congregational Church		500—258
WPDQ	Buffalo, N. Y., Hiram L. Turner		50—205.4
WPG	Atlantic City, N. J., Municipality of Atlantic City		500—299.8
WPRC	Harrisburg, Pa., Wilson Printing and Radio Co.		100—215.7
WPSC	State College, Penna., Pennsylvania State College		500—261
WQAA	Parkesburg, Pa., Horace A. Beale, Jr.		500—220
WQAC	Amarillo, Tex., Gish Radio Service		100—234
WQAE	Springfield, Vt., Moore Radio News Station		50—246
WQAM	Miami, Fla., Electrical Equipment Co.		100—263
WQAN	Scranton, Pa., Scranton Times		100—250

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Call Letters	Name	Location	Power & Wave Length
WQAO	New York, N. Y., Calvary Baptist Church		100—360
WQJ	Chicago, Ill., Calumet Rainbow Broadcasting Co.		500—447.5
WRAF	Laporte, Ind., The Radio Club, Inc.		100—224
WRAK	Escanaba, Mich., Economy Light Co.		100—256
WRAM	Galesburg, Ill., Lombard College		100—244
WRAV	Yellow Springs, Ohio, Antioch College		100—263
WRAW	Reading, Pa., Avenue Radio & Electric Shop		10—238
WRAX	Gloucester City, N. J., Flexon's Garage		500—268
WRBC	Valparaiso, Ind., Immanuel Lutheran Church		50—278
WRC	Washington, D. C., Radio Corp. of America		1000—468.5
WRCO	Raleigh, N. C., Wynne Radio Co.		100—252
WREC	Coldwater, Miss., Wooten's Radio & Elec. Co.		10—254
WREO	Lansing, Mich., Reo Motor Car Co.		500—285.5
WRHF	Washington, D. C., Washington Radio Hospital Fund		50—256
WRHM	Minneapolis, Minn., Rosedale Hospital		50—252
WRK	Hamilton, Ohio, Doron Bros. Electrical Co.		100—270
WRM	Urbana, Ill., University of Illinois		500—273
WRMU	Richmond Hill, N. Y., M U-1 (Yacht) A. H. Grebe		100—236
WRNY	New York, N. Y., Experimenter Publishing Co.		500—258
WRR	Dallas, Tex., City of Dallas, Police and Fire Signal Department		350—261
WRST	Bay Shore, N. Y., Radiotel Mfg. Co.		250—215.7
WRVA	Richmond, Va., Larus & Bro. Co.		1000—256
WRW	Tarrytown, N. Y., Tarrytown Radio Research Laboratory (Koenig Bros.)		500—273
WSAI	Mason, Ohio, United States Playing Card Co.		5000—325.9
WSAJ	Grove City, Pa., Grove City College		250—229
WSAN	Allentown, Pa., Allentown Call Publishing Co.		100—229
WSAR	Fall River, Mass., Doughty & Welch Electrical Co.		100—254
WSAU	Chesham, N. H., Camp Marienfeld		10—229
WSAX	Chicago, Ill., Zenith Radio Corp.		100—268
WSAZ	Pomeroy, Ohio, Chase Electric Shop		50—244
WSB	Atlanta, Ga., Atlanta Journal		1000—428.3
WSBC	Chicago, Ill., World Battery Co.		500—209.7
WSBF	St. Louis, Mo., Stix Baer & Fuller		250—273
WSBT	South Bend, Ind., South Bend Tribune		250—275
WSDA	New York, N. Y., City Temple		250—263
WSKC	Bay City, Mich., Worlds Star Knitting Co.		100—261
WSM	Nashville, Tenn., National Life & Accident Ins. Co.		1000—282.8
WSMB	New Orleans, La., Saenger Amusement & Maison Blanche Co.		500—319
WSMH	Owosso, Mich., Shattuck Music House		20—240
WSMK	Dayton, Ohio, S.M.K. Radio Corp.		500—275
WSOE	Milwaukee, Wis., School of Engineering of Milwaukee		500—246
WSRO	Hamilton, Ohio, Radio Co. (Harry W. Fahrlander)		100—252
WSUI	Iowa City, Iowa, State University of Iowa		500—483.6
WTAB	Fall River, Mass., Fall River Daily Herald Publishing Co.		100—266
WTAC	Johnstown, Pa., Penn. Traffic Co.		100—268
WTAD	Carthage, Ill., Robert E. Compton		50—236
WTAG	Worcester, Mass., Worcester Telegram Publishing Co.		500—268
WTAL	Toledo, Ohio, Toledo Radio & Electric Co.		10—252
WTAM	Cleveland, Ohio, Willard Storage Battery Co.		3500—389.4
WTAP	Cambridge, Ill., Cambridge Radio & Electric Co.		50—242
WTAQ	Osseo, Wis., S. H. Van Gorden & Son		100—254
WTAR	Norfolk, Va., Reliance Electric Co.		100—261
WTAS	Elgin, Ill. (near), Charles E. Erbstein		2500—302.8
WTAT	Boston, Mass. (portable), Edison Elec. Illuminating Co.		100—244
WTAW	College Station, Tex., Agricultural & Mechanical College of Texas		500—270
WTAX	Streator, Ill., Williams Hardware Co.		50—231

(*Continued on page* 876)

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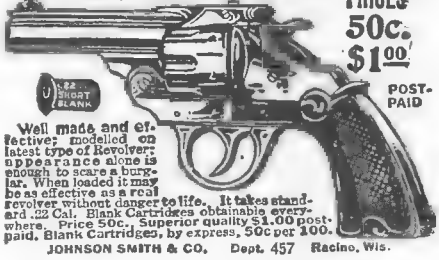

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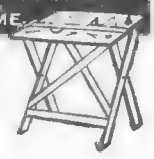

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Tarrano the Conqueror

By RAY CUMMINGS

(*Continued from page* 817)

by the Earth. Into our vessel's small instrument room, where Tarrano spent most of his time, reports of the news occasionally drifted in. But his connection—small and inadequate—was often broken. Nor did Tarrano this time seem interested in having Wolfgar, Elza and me learn the news. Yet it was not unfavorable to him. I gathered that the Earth formally had accepted his declaration of war. Relations with Venus—and with Mars also, had been discontinued. The mails no longer left. The helios were stopped. But, so far as I could learn, the Earth was undertaking no offensive action. For the present, certainly.

Soon we were beyond reach of all messages save helios, which were not in operation. And in another day news began reaching us from Venus. But from this Tarrano barred us.

I saw Venus, as we dropped upon it, first as a tremendous lovely crescent of silver beneath us. A crescent first, and, as hours passed, the darkened area took shape. A ball hanging there in space. Growing almost momentarily larger. Soon we could distinguish cloud areas. Then the land—the water. A ball filling half our lower segment of sky. Then all of it.

We reached the Venus atmosphere, passed through cloud masses, and out again into the brilliant sunshine. Below us, glowing with the glory of mid-day, lay the Venus Central State. Rolling hills with distant mountain peaks, the highest of them faraway, glittering white with the sunlight on their snow-caps.

A land of warmth and beauty. Dazzling green, with a luxuriant vegetation, tropical yet strange.

As we dropped lower, I sat alone, gazing downward. We were passing over the land now, at an altitude of no more than twenty thousand feet. A vivid land. Vivid sunlight; inky shadows; a green to everything—a solid, brilliant green. Amid it, spots of other colors; splashes of yellow; patches of scarlet as though some huge field were massed with scarlet blossoms. And trailing silver threads—rivers and streams. Or again glittering silver lakes nestling in the hills.

A fairyland of beauty. Yet as I gazed, it seemed not the fairyland of a child. Not childish, but mature; for I could not miss in its aspect, a warmth, a quality of sensuousness. A land of dalliance and pleasure of the senses. And I realized then why the Venus-people derived all their advancement of science and industry from Earthly and Martian sources. A land of luxury and physical ease. People, not primitive—but decadent.

I became aware of Wolfgar at my elbow. "It is very beautiful, eh Jac Hallen?"

"Beautiful—yes. You've been here before, Wolfgar?"

He nodded. "Oh yes. Soon we will reach the Great City. That too is strange and beautiful."

Elza saw us together and joined us. The Great City presently came into distant view. Wolfgar, with that gentle voice and smile characteristic of him began to describe to us what we should see. Abruptly Elza said:

"I have never really thanked you, Wolfgar. You saved my life—there when Tara attacked me."

He gestured. "Your thanks are more than such a service deserves."

As though the subject had suggested Georg and Maida to him, he added.

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"I am wondering where Georg Brende and the Princess Maida may be."

I fancied then that I saw a quality of wistfulness in his eyes. A gentle little fellow, this Mars-man. Queer and brooding, with strange thoughts not to be fathomed. He added as though to himself: "I have often wondered—" Then stopped.

Elza and I had discussed it. We felt sure that Georg and Maida had been taken to Venus. They could have had only a few hours' start of ourselves. Yet this vessel we were in was unusually slow. We felt convinced that they had already arrived on Venus—had been there perhaps already for a day.

We discussed it now with Wolfgar as the Great City came under us; but soon we fell silent, gazing down into this beautiful capital of the Central State.

It lay in a broad hollow, a large, irregular circular bowl surrounded by gently sloping hillsides. The bowl was entirely filled by water—a broad flat lake of silver which from this height showed us its pearly bottom. On the water—seen from above—the houses seemed floating—clusters of lilly pads on a placid shining pool. They were, in reality, flat cubical buildings solidly built of rectangular blocks of stone, standing just above the water level on solid stone foundations. Always green and white—stones like blocks of smooth, polished marble, set in green and white patterns. Balconies and cornices of what might have been gleaming, beaten copper. Flat roofs, edged with scarlet flowers.

Some of the buildings were low and small. Others of several stories, pretentious and ornate. One very large, like a palace, standing alone on its verdant island.

The houses were mostly gathered in clusters of various shapes and sizes. Yet a semblance of order prevailed. Winding streets of open water lay between the groups. There were trellised walks and arching spider bridges, sometimes over the streets, sometimes joining one house to another.

Here and there I saw lagoons of open water, dotted with small green islands like parks—islands on which the vegetation grew far higher and more luxuriant than any even in the tropics of our Earth. Vegetation always under careful training and control. Profuse with flowers, vivid and gigantic. The houses too, were roofed with gardens—sometimes with pergolas and trellises of the aerial scarlet blossoms. Occasionally—these latter details I observed as we descended close upon the city—I saw houses with a tiny swimming pool on the roof—a private pool hidden in masses of colored flowers.

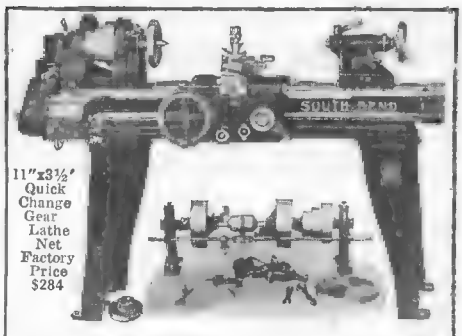
A playground—the playground of Venus. It seemed very backward—uncivilized. And then Wolfgar pointed out the surrounding hillsides. On them, cleared of their vegetation, our modern civilization stood gaunt and efficient. Towers, aerials, landing stages, aerial trams, factories, tall stacks over the dynamo houses belching thick black smoke, which artificial wind-generators carefully blew away from the city.

In the midst of their hillside ring of necessary modernity, the people of the Great City had kept their playground inviolate. Work, science, industry—all necessary. But the real business of life was pleasure. Art, music, beauty. . . . And I am not far from thinking that unless abused, their formula is better than ours.

CHAPTER XVII

The Violet Beam of Death

We landed on a stage at the summit of one of the nearer hillsides. Our coming—unheralded since we had carried no sending instruments—created a furore. The work-



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ers rested to watch us as we disembarked. It was not so different a scene, here on the hill, than might have occurred on Earth. But then we took a moving platform, down the hill and to the water's edge. A barge was awaiting us—a broad flat vessel of gaudy trappings. A score of attendants lined its sides, each with a pole to thrust it through the shallow water. And on its high-raised stern, beneath a canopy was a couch upon which Tarrano reclined, with us of his party at his feet.

A royal barge, queerly ancient, barbaric—reminding me of the flat, motionless pictures of Earth's early history. Yet it was a symbol here on Venus, not of barbarism, but of decadence.

We started off. I may have given a false idea of the size of the Great City. Its lake, indeed, was fully fifteen miles or more in diameter. Half a million people lived on or close around that placid stretch of water.

The news of Tarrano's arrival had instantly spread. Graceful boats, all propelled by hand, thronged our course. From them, and from every house-window, balcony and roof-top, a waving multitude cheered the coming of the Master. The new Master, to whom so recently they had given their allegiance—the Master who in return was to endow them with life everlasting.

It was a gay, holiday throng—cheering us, tossing flower-petals down upon us as we passed majestically beneath the bridges. Yet among these gaudily dressed women and

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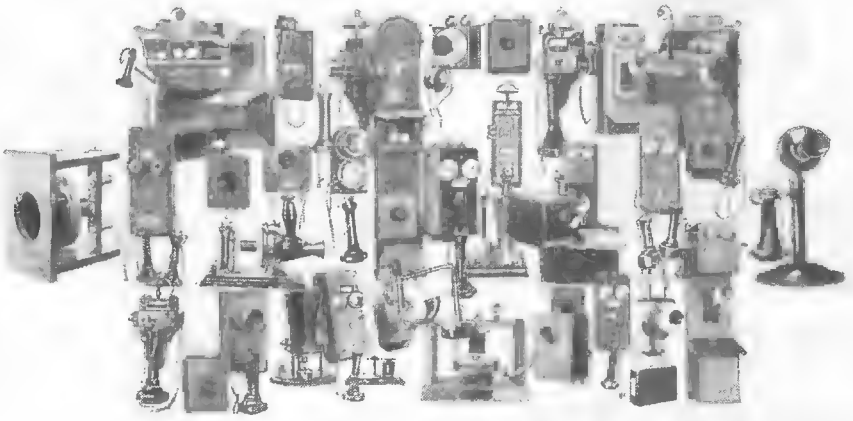
men with the luster of wealth and ease upon them, others mingled. Others of a lower class, poorly dressed, with the badge of servitude upon them, enthralled in a social peonage which I did not yet understand.

"Slaans," Wolfgar called them. A term half of derision, half contempt. And Wolfgar pointed one out to me. A huge grey, surly-looking fellow passing in a one-man shell or boat of tree-fibre. He gazed up at us as he went by—a furtive glance of cold, sullen fury. Unmistakable. And I saw it again on others of his kind—men, women, even children who gazed at us with big, round eyes. A dumb, sullen resentment, with a smouldering fury beneath it.

During the trip, which may have taken an hour, I remarked something also, which did not at the time seem significant but very soon I was to recall it and understand its import. Argo, of course, was still with us. As we embarked upon the barge, a man evidently an official of the Great City had paid his humble respects to Tarrano and then withdrawn to a further part of the vessel, drawing Argo with him. I saw the two in close conversation. The official evidently was telling Argo something of importance. I could see Argo growing indignant and then his eyes gleaming, a leer upon his cruel lips.

During the trip Tarrano sat calm, half reclining on his couch—sat watching with his keen expressionless eyes the applause of the multitude. It was, I think, and I believe he felt it also, the height of his career up to



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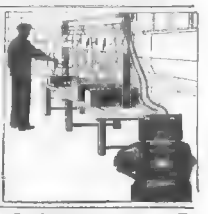

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that time—this triumphant entry into the greatest city of Venus. He did not speak, just sat watching and listening, with a half smile of triumph pulling at his mouth. Yet I know too, that those keen eyes of his did not miss the sullen glances of the slaans.

The weather, as always in the Venus Central State, was warm—a luxurious tropic warmth. And now I felt—as I had seen from above—the languorous, sensuous quality of it all. Music, mingled with the ripple of girlish laughter and cheers, came from the houses as we passed. Soft, fragrant flower-petals deluged us. The very air was laden heavy with exotic perfumes from the flowers which were everywhere.

We arrived at last at what appeared to be a palace—a broad, low building of polished stone, on an island of its own. It was the building I had noticed when first we saw the Great City from above. Gardens were about the building, and on its roof. Flowers lined its many balconies.

We drew up to a stone landing-place.

"The palace of the Princess Maida," Wolfgar whispered.

But I had no time to question him. Attendants appeared. A queer mixture. Incongruous men of science, armed with belts of instruments. They greeted Tarrano humbly; escorted him away.

Other attendants. Natives of the city, in the flowing, bright-colored robes we had seen everywhere. A group of them—laughing young girls—descended upon us.

"The Princess Maida bids you welcome."

They hurried us into the building. I was surprised. Tarrano had seemingly ignored us. It was quite as though we were

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honored guests, arriving in the Central State when Maida was its ruler.

Led by the girls, we passed upward into the building past splashing fountains, cascades of perfumed water with tubes of silver light gleaming in its midst; and were thrust at last into a room.

The girls withdrew. Across the floor-polished stone, with heavy woven rugs upon it—Georg and the Princess Maida advanced upon us.

Our greetings were brief. I could have talked to them both for a day, questioning them; and they, no doubt had as much to ask of us. But they were solemn, grave and anxious.

"Not now, Jac," Georg said to check me. "Elza dear—I have been so worried over you."

"But——" I demanded.

"Jac—the situation here—our own cause—the safety of our Earth itself—this Tarrano—"

But Maida stopped him. "The very air has ears. Not now." Her glance turned to Wolfgar; her slim hands went out to greet him. "Wolfgar, my friend. It is good to see you here."

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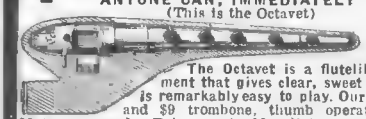

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Wolfgar knelt before her, gazed for one instant into her eyes, and then with head bowed, brushed the hem of her robe to his face.

She laughed gently. "Stand up, Wolfgar. I would not be the Princess Maida to you now. Only—your friend. Your grateful friend."

There was a sudden soundless flash. From across the room a beam of violet flame darted at us. It struck just between Maida and Wolfgar, as he rose from his knee. Both of them involuntarily stepped backward, apart from each other. And between them, breast high, the flame hung level across the room. Maida was on one side of it; all the rest of us, on the other.

I turned. At the door, Argo had appeared. From a black object in his hand, the beam was streaming. He rested the black thing on a wall ledge so that the beam hung level.

"Stand where you are, all of you." He started toward Maida, behind the beam from the rest of us.

Georg made as though to leap forward, but Wolfgar restrained him. "Wait! You don't understand—that's death!"

I saw now that the violet light had encircled us. Only Maida and Argo were outside it. He was approaching her, with a cylinder in his hand. The ray from it struck her without power of movement or speech. Her eyes, terrified, turned to us. Again Georg would have leaped, but Wolfgar shouted, "Wait! That's death! Don't you understand?"

Argo was leering. "Death? Yes! If you touch that violet light! Death, of course. But you won't touch it! You will stand and watch—stand silently for you know that if you shout, the vibrations will bring the beam upon you. You won't move—you'll stand and watch me kill your Princess Maida—not quickly—she is too beautiful for that. You, Georg Brende—you, Wolfgar, traitor from Mars. You shall see your Princess Maida die—this would-be traitoress to my Master Tarrano!"

With all the strength of his puny body Wolfgar flung Georg backward—safely away from the deadly violet beam. And then, without warning, without a cry which would endanger us, the little Mars-man sprang headlong, into and through the violet beam of death.

(*To be continued*)

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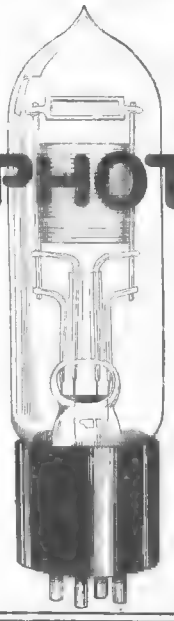

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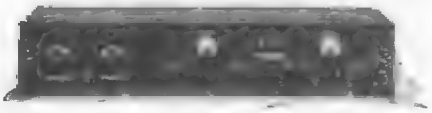

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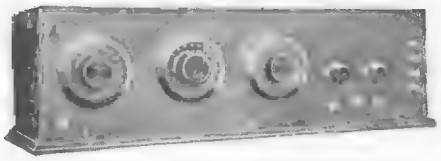

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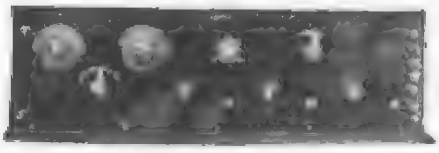

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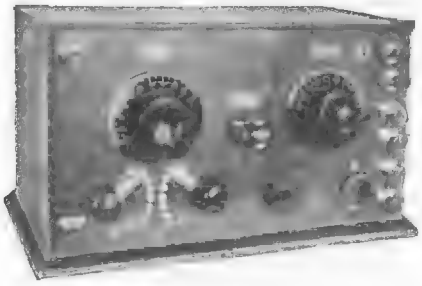

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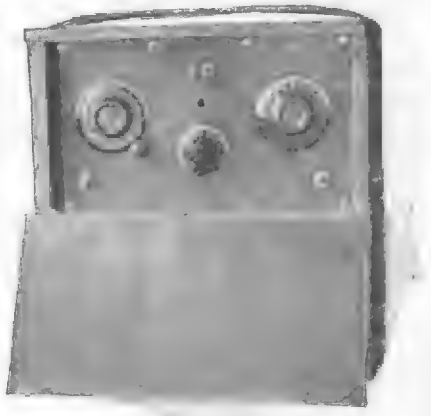

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How to Follow WRNY

By DR. CHAS. D. ISAACSON

(*Continued from page 833*)

cast of "Mary, Mary," including the principals, Mary Saxon and Harry Puck were there another evening and it must not be forgotten that on Navy Day, the "Captain Jinks" company, including Ada May and chorus, broadcast from the U.S.S. *Illinois*, or that Theatre Guild players brought us many of the cast of "Arms and the Man."

"Whose Birthday Today" is now in mighty good hands. The mysterious Miss Cattell takes names and birthdays and tells us what they mean, numeralogically and astrologically, and, although it has nothing to do with the subject, Albert McCann has been doing the same thing with "Food," Dr. Block with "Mental Advice" and Dr. Finkel with "Diet."

I think that one of the loveliest of all features has been the "Twilight Musicales" on Sunday afternoon, although if Dr. Christian Reisner continues to bring in men like Senator Copeland, Dr. Buckner, and others, he may lead the other features.

As I look over the light opera presentations, I recall that the Mme. Andres Parker Singers gave "The Pirates of Penzance," and the Gordon Hampson Light Opera Company presented "Robin Hood."

Do you know that WRNY had the distinction of bringing in more political speakers than any other station? Frank Waterman, ex-Governor Whitman, Justice McKee, George Gordon Battle, Senator Walker, Ida Slack, not to mention many others.

Do you know that we had this month such speakers as Henry W. Taft and Judge Alton B. Parker?

Of course, all the ladies know what "Pictorial Review Says," and everybody knows that Charles Dana Gibson comes to WRNY with that laughable feature, "Life's Jokes."

You already know that Ben Bernie is back, don't you? Yes, he is—with his famous orchestra.

As I look back over the book, the biggest of all things that we have done at WRNY looms up—the WRNY Artists' gathering. By the way, I must tell you that the front of our big book is a picture of a photo taken that night. About 300 were present and everybody broadcast for one minute. I wonder how many listened in that night.

The Radio Theatre Players presented "Nothing But the Truth" this month, and the listeners all said that they could "see" the whole thing, as well as hear it. The Radio Art Theatre gave a performance of Moliere's "The Affected Young Ladies."

The Women's Hour is getting to be quite a feature. Mrs. Edgar Cecil Melledge has been taking charge of one of these groups and among the speakers so far presented have been Miss Helen Varick Boswell, Mrs. Angelique V. Orr, Mrs. Ida Slack, Mrs. Aido Mayo and Mrs. Bedell Parker.

I will see you again next month.

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Stop It

Cut it out right now. Determine this minute that you're nobody's fool. If you only knew what a strong, robust, healthy body meant, you would have had one long ago. Take it from me, fellow, it's great to be healthy. I've been both ways and I know. Let's you and I work this thing out. What do you say? I'm a muscle builder. I'm a pep builder. I've taken the sickliest looking scare crows you'd ever want to look at, and I've built them up into real big, powerful, virile men. Listen to this and I'll shoot you off a few things that are coming your way. In just 30 days, I'm going to add one full inch onto those arms of yours. Yes, and two inches to your chest in the same length of time. But that's nothing. Get this. I'm going to broaden your back and deepen your chest so that every breath you take will drag a full load of oxygen into your lungs, shooting life-giving red corpuscles into every nook and corner of your body. I'll broaden your shoulders and strengthen your neck I'll put an armor-plate of muscle over that old tummy of yours. I'll shoot a quiver up your spine that will make you feel like turning flipflops. Meanwhile I'll work on every muscle inside your body, pepping up your vital organs and putting fire into your whole system. Good? You're durn tootin' it's good. It's wonderful. And the best of it is—I don't just promise these things. I GUARANTEE THEM. You take no chances with me. It's a sure bet. Well, what do you say? Let's ride.

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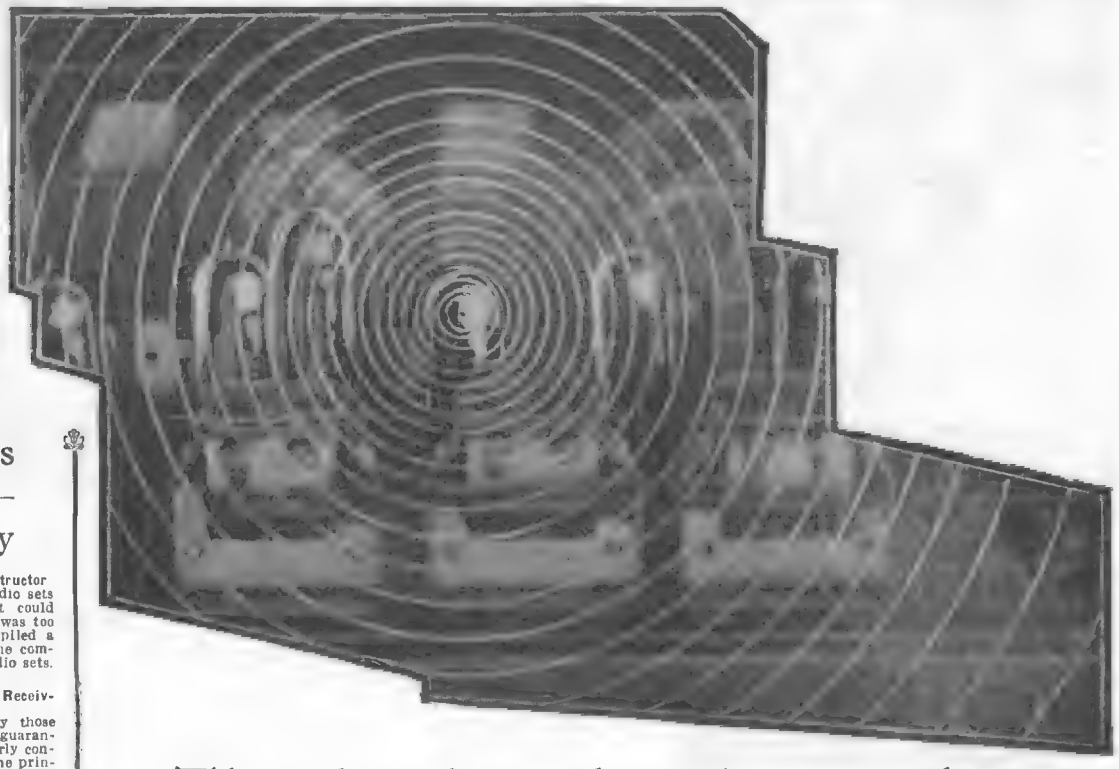

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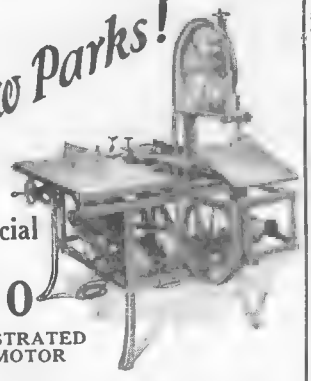

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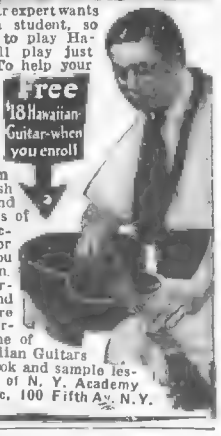

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Grid Leaks—The Biggest Little Thing in Radio

By FRANCIS R. EHLE

(*Continued from page* 835)

In purchasing grid leaks great caution should be exercised to purchase only a reliable type. Carbon paper, impregnated paper or pencil mark grid leaks when examined under a microscope, look much like coarse sand paper. When an electrical current is passed through them, as is constantly occurring in the grid circuit of the detector tube, a minute arcing effect is noticed, so small as to be invisible but its effect can easily be heard as a hissing, rushing sound in the reproducer. This very considerably affects the quality and sensitivity of the receiver. Use only good grid leaks—preferably metallized.

Ordinarily these values of leaks for various tubes are correct.

Tube	Grid leak value
UV 201-A or 301-A	2 to 3½ Megohms
DeForest DV-6	3 Megohms
WD-11 or WD-12	3 to 5 Megohms
UV-199 or C-299	3 to 5 Megohms
UV-200 or C-300	1 to 2 Megohms

The exact value of grid leak to use depends upon the length of time that the tube has been in operating service, the plate voltage, and the type of circuit employed. As the value is oft-times a deciding factor in the sensitivity of the receiver a number of values should be experimented with or a reliable variable grid leak ranging from one to five megohms used.

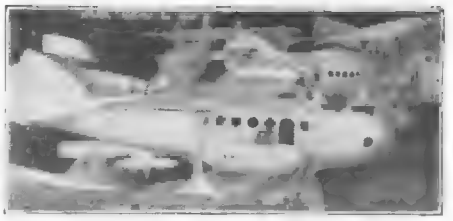
A new process for the manufacture of grid leaks to be used with radio receiving sets incorporates many advantages and produces a high resistance of either fixed or variable value that is absolutely constant in operation. At the factory where these little, yet all-important instruments are made, the process followed is essentially as follows. Glass is spun into 500 foot lengths in the form of a small wire of absolutely uniform diameter. This material is wound upon a reel and then passed through a solution of conducting material. A certain amount adheres to the surface of the glass which then is passed through a high temperature furnace. This latter device is so constructed that a steady flow of gas passes over the surface of the glass wire. In this way, the conducting material is annealed on the surface of the glass and the result is a very uniform thickness of metal deposited upon a perfect insulating base. The resulting combination of glass and metal is then passed through an insulating varnish solution and allowed to dry. The long length is then cut up into short strips of uniform size and then goes to the assembly room. Here the metal surface on the glass rod is actually soldered to the metal caps forming the terminals of the grid leak. It is also, of course, enclosed in a glass or other protecting tube so as to be impervious to the action of atmospheric and temperature changes.

The soldering of the fine thin metal film to the brass caps is a most delicate process and upon it depends the ultimate success of the grid leak. It can be seen that perfect contacts can be made in this way and that the resulting grid leak will be most efficient.

During the entire process of annealing the metal to the glass and of varnishing the surface, the resistance per unit length is constantly checked so that any discrepancy can be corrected before it has gone too far. Thus perfect grid leaks are assured.

SIEGBAHN GETS NOBEL PHYSICS PRIZE

The Nobel physics prize for 1924 has been awarded to Karl Manne Georg Siegbahn, Professor of Physics at Lund University, Sweden, says a recent Associated Press report.



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Answers to Scientific Problems and Puzzles

(*Continued from page* 818)

1. According to the well known principle of Archimedes an object immersed in a fluid is buoyed up by a force equal to the weight of the fluid displaced. If the balloon just barely rises in the atmosphere outside the case it is evident that it is just a little bit lighter than the volume of air which it displaces. Hence, if it is placed inside the case the balloon will displace less than its own weight of hydrogen (a gas about two twenty-ninths the specific gravity of air) and will sink.

2. When an electric current follows an iron pipe through the ground it produces the greatest electrolytic action at the point where it leaves the pipe. This is because it decomposes the water at the surface of the pipe into hydrogen and oxygen gas. The hydrogen passes with the current away from the pipe but the oxygen goes against the current to the surface of the pipe where it combines with the iron to form oxide or rust. From the diagram it will be seen that if the current leaves the pipe at the point C, where the greatest rusting is produced, the trolley wire must be positive to the track.

3. Imagine a plumb line (OA) dropped from the center of gravity (C.G.) of the car. If it strikes the ground as at A^1 between the wheels, the car will not tip over; but if it passes below the lower wheel to such a point as A, the car will be unstable and will overturn. A solution of the right triangle OAB will show that line OA. will fall below the lower wheel and hence the car is in an unstable position.

4. The darkening of an old electric light bulb is due to a thin deposit from the filament that is thrown off gradually while the filament is heated to incandescence.

5. When an electric current enters a meter it passes, in general, through two different coils in the instrument. One of these is a coil of low resistance that is placed in series with the lamps in the house. This is called the current coil. No current can pass through it unless power is being drawn in the building. The other coil, one of high resistance, is connected directly across the line. It is called the potential or voltage coil. Since it is across the line a small current will pass through it even when no power is being drawn beyond the meter. It is this current through the voltage coil that passes through the lamp indicated in our circuit and thus makes it glow to a dull red even when the switch on the other side of the meter is open. The power used by this voltage coil does not figure in the meter reading, however, as the meter will not operate unless current passes through both coils.

6. An electrical discharge between the terminals in either regulator will heat the platinum tube very hot. Now platinum when hot has the peculiar property of permitting hydrogen to pass through it while excluding at the same time the gases of the atmosphere. Furthermore, hydrogen always tends to pass from a region where it is more dense to a region where it is less dense. Hence a discharge in (A) where the hydrogen is under pressure will cause it to pass into the highly evacuated X-ray tube, whereas a discharge in the regulator (B) will cause it to pass from the X-ray tube to the atmosphere where the density of the hydrogen is even less than that of the X-ray tube, although the actual pressure is very much greater.

7. Adding the lamp (C) to the circuit reduces the resistance between its terminals to just half that of a single lamp since it

(*Continued on page* 873)

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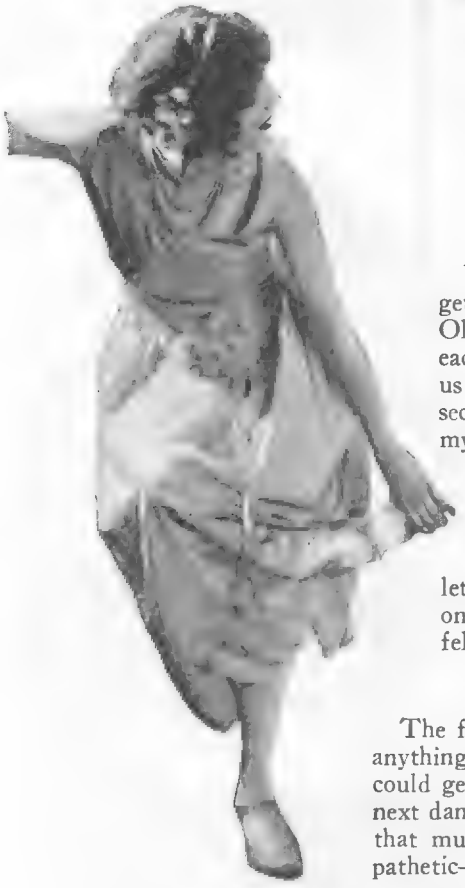
How I Was Shamed into Popularity!



For some reason I could never get out of the wall-flower class. But one night I had a bitter experience that changed everything. Here's what happened.

By JAMES PRESTON

You know, I once thought nerve alone was enough to get one by anywhere. That is, I thought so till I met Olive. You never in your life saw two people take to each other the way we did. It was sheer joy to both of us just to be together. She liked me a lot and made no secret of it, and—well, I'll admit I tumbled pretty hard myself. If only that dance party hadn't come along.

But dances are what parties are made for. I sat out two or three fox-trots watching Olive spin around in the arms of other men. How easily and gracefully they glided along. And there I was, sitting back and letting these other fellows monopolize the prettiest girl on the floor. I felt like—well, you can imagine how I felt! I decided right there to take a turn with her myself.

Just a Poor Boob

The fact that I didn't know how to dance well didn't mean anything to me—*then*. It looked easy enough, and I thought I could get by. So at the very first note of the orchestra for the next dance, I swallowed whatever fear I felt, and taking a hold that must have been screamingly funny if it hadn't been so pathetic—I started what I thought was dancing.

Wherever did I get my nerve? And where did that girl ever get her wonderful patience? I must have stumbled twenty times—and then in the middle of the dance she winced with pain and stopped to rub her toes.

"Jack," she said—her voice tried hard to be friendly—"Jack, let's not finish this dance. I'm too tired anyway," she added, struggling with herself to be nice to me.

I guess I turned a million colors. Just then I wanted the ground to open up and swallow me. It was quite a while before I saw Olive again.

But that night I sat up and turned that terrible experience over and over in my mind. And suddenly it dawned upon me why I was so rarely able to make a date with the girls of my social set. With equal suddenness it occurred to me that there was a remedy—a quick, simple remedy that I had read about time and again, yet never heeded.

A Free Booklet That Started Something

The very next morning I mailed a magazine coupon to Arthur Murray, America's foremost dancing instructor, asking him for his booklet, "A Short Cut to Popularity," and the test lesson, all entirely free. Here was an easy, inexpensive way to find out whether I could learn to dance, and learn in a few evenings.

A 32-page booklet and the free test lesson came at once. The booklet explained to me how easy it is to become a good dancer—that dancing is as easy as walking once you know how—and how quickly anyone can master the art.

It showed me how, right in my own room, without music or partner, and with no one to watch me, I could learn to do all the latest steps in a remarkably short time. It explained how the ability to dance well gives poise and self-confidence in the presence of strangers—how it helps to overcome timidity and awkwardness—how it enlarges one's circle of friends—makes one welcome at every affair—and brings many hours of joyous fun and good times.

What I Learned in Just a Few Moments

There was a lot more, of course. That booklet was a revelation to me. But the free test lesson—well, what it did for me amazes me yet when I stop to think of it. I tried the steps as explained and diagrammed in the lesson and found that the hardest dance step took me only a few minutes to learn. Was I tickled? I was ready to cheer! All I wanted then was another chance to get on a dance floor. I could just imagine how surprised my friends would be—for I knew that *now* I could show them a thing or two.

They were—and the girls are only too glad to accept when I ask for a dance now. I haven't known a lonesome evening since I mailed the coupon.

Whether you've had an experience like mine or not, take a tip from one who knows, and avoid the possibility of embarrassment. You can do it—anyone can do it—this easy, pleasure-giving way.

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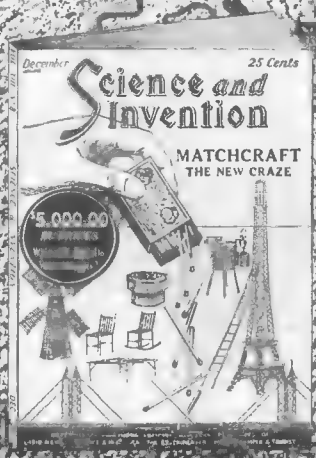

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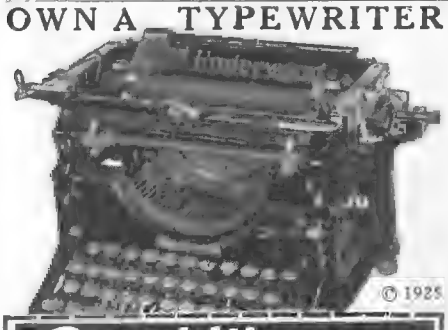

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Answers to Scientific Problems and Puzzles

(*Continued from page* 870)

offers another route for the current to pass between its terminal points M and N. Then since the section LM has half as much resistance as that of MN it will get one-third of the total applied voltage. To be exact, there will be 73⅓ volts applied to the two lamps A and C and 146⅔ volts to the lamp B. But since B is getting more than 110 volts it will burn brighter than usual, whereas the lamps A and C will be less bright since they are getting less than normal voltage.

8. Under proper conditions of illumination the screen has a good reflection or image in the window pane behind it. This image is not readily noticed because it is seen through the meshes of the overlying wires. But, for a given position of the obeserver some of the screen wires will be in position to exactly overlap the image of the wires behind, while for neighboring ajoining wires of the screen the overlapping will not be exact. In the former case more light will be reflected from the window to the eye than in the latter case. Hence there will be alternate light and dark regions which will appear as striations upon the screen.

Harnessing Bay of Fundy Tides

(*Continued from page* 801)

sale to outside communities of electric power developed within the state. This has been overcome by popular vote, while the sanction of Canada and the Federal water power commission remains to be obtained.

Those who have visited the Bay of Fundy and the country thereabout no doubt recollect that the great tidal current or bore which daily rushes up the Bay of Fundy with great force, causes a rise and fall at the north end of the Bay of 50 to 60 feet. Mr. Cooper does not attempt to use these unreliable tidal currents, except for the fact that they will help to store water in his upper reservoir. The present scheme, as explained previously, has to rely for its power development solely upon the difference in level betwen high tide and low tide.

The water level in the upper storage pool will fall somewhat between high tides, while the water in the lower pool will rise slowly as the water discharge from the turbines pours into it. The mean head of water will be reduced but a few feet, however, it is pointed out, and will not reduce the power output of the plant to any marked extent.

One of the great outstanding advantages of this scheme for developing electrical energy from the rising and falling tides lies in the fact that no dependence has to be placed on seasonal droughts as is the case where fresh water river power developments are under construction, as with the Muscle Shoals' plant. If the summer is dry, or if there are but few snow or rain storms during the winter, it makes no difference to the proposed Bay of Fundy plant, for the Atlantic Ocean will continue day in and day out to refill the upper pool or storage reservoir just as regularly as clockwork. The St. Croix River flows into the upper pool, which is Passamaquoddy Bay.

Mr. Dexter P. Cooper, who has conceived this tremendous power development scheme is a brother of Colonel Hugh Cooper of the United States Army engineers who built the Wilson Dam at Muscle Shoals, and which piece of construction work Mr. Dexter Cooper helped to engineer and build.

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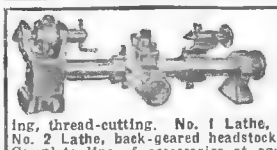

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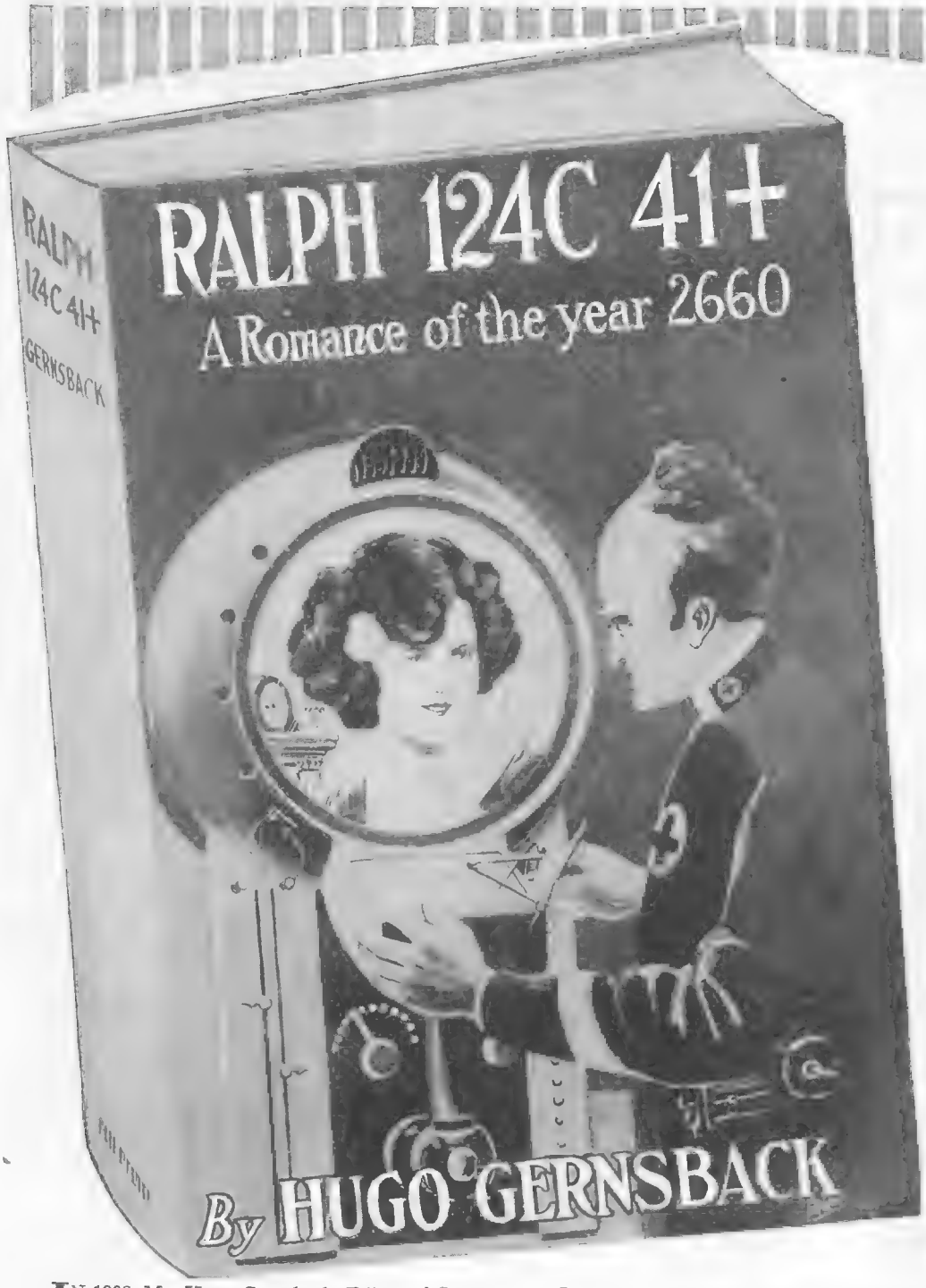

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Orthophonic Radio Phonograph

By H. WINFIELD SECOR, E.E.

(*Continued from page* 803)

Any phonograph will be vastly improved with a 4½ to 6 foot horn placed in it, as shown in the accompanying drawings, but the ultimate in beautiful sound reproduction so particularly noticeable in some of the lighter musical selections, where delicate shadings of the music occur, is only made possible by this clever masterpiece of the engineering laboratory.

A RADIO ORTHOPHONIC PHONOGRAPH

Instead of spending from five thousand up to fifty thousand dollars or more for an elaborate pipe organ, the palatial home owner of today may spend instead but $1,000.00 and have in his home one of the new radio orthophonic phonographs shown elsewhere. This new radio orthophonic outfit has all the necessary controls on it which enable the owner to have three different forms of musical reproduction. The first is regular acoustical reproduction of music from a phonograph record, through the medium of the usual needle, orthophonic sound box and tone arm, together with the orthophonic horn. If greater volume of sound is desired than that required for the ordinary residential living room, the electrical pick-up may be placed on the record instead of the ordinary needle and sound box, and the electrical currents produced by this pick-up device may be passed into a vacuum tube amplifier of several stages. This amplifier contains a remarkable ballast tube which compensates for changes in the alternating current line voltage, and some of the tubes serve as rectifiers, so that A, B and C current for the tubes of the radio set is supplied.

The greatly amplified voice currents coming out of the amplifier are passed into a new orthophonic loud speaker which embodies all of the qualities of the new sound box, in that it can cover 5½ octaves of sound and will not blast or distort any of the notes. This loud speaker is also used in connection with the eight tube Super-Heterodyne built into the cabinet as the photographs show, the loop aerial for which is enclosed in the cabinet also, the loop being rotated by a disk or dial mounted in the instrument shelf at the top of the cabinet.

No batteries are required whatever, except in the event that the owner has no A.C. 110-volt supply in his district, when batteries may be placed on the shelves provided in the back of the cabinet, and the whole radio phonograph may be operated from the batteries only.

When using the radio or the electrical phonograph pick-up in connection with the the orthophonic loud speaker, the sound waves are switched into the orthophonic horn by means of a three-way sound valve, the control lever of which is placed in a convenient position. The phonograph motor is driven by an induction type A.C. motor, and when using the electrical pick-up for phonographic reproduction the voice currents from the pick-up device pass through a scratch reducer filter.

One of the interesting features of the new radio orthophonic machine is that a jack is provided on the instrument board whereby one or more external loud speakers placed at any desired point about the house or hall, may be connected with the amplifier circuit when reproducing radio music or electrical phonograph music.

The radio set incorporated in this *de luxe* radio phonograph is an eight-tube straight super-heterodyne of the R.C.A. type, and will do most anything one could expect of a radio set. One of its features is the new uni-dial control.

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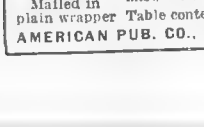

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New Helicopter-Airplane

By C. A. OLDROYD

(*Continued from page 799*)

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Broadcast Calls

(*Continued from page 860*)

Call Letters	Name	Location	Power & Wave Length
WTAZ	Lambertville, N. J., Thomas A. McGuire		15—261
WTG	Manhattan, Kans., Kansas State Agricultural College		50—273
WTIC	Hartford, Conn., Travelers Insurance Co.		500—348.6
WWAD	Philadelphia, Pa., Wright & Wright, Inc.		250—250
WWAE	Plainfield, Ill., Lawrence J. Crowley (Alamo Ball Room)		500—242
WWAO	Houghton, Mich., Michigan College of Mines		250—263
WWGL	Richmond Hill, N. Y., Radio Engineering Corp.		500—212.6
WWI	Dearborn, Mich., Ford Motor Co.		500—266
WWJ	Detroit, Mich., Detroit News.		1000—352.7
WWL	New Orleans, La., Loyola University		100—275

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So that was it! That was the reason why I had been passed over time and again when promotions were being made! That was why I was just a plodder—a truck horse for our firm, capable of doing a lot of heavy work, but of no use where brilliant performance was required. I was a failure unless I could do what seemed impossible—learn to use words forcefully, effectively and convincingly.

In 15 Minutes a Day

And then suddenly I discovered a new, easy method which made me a powerful speaker almost overnight. I learned how to bend others to my will, how to dominate one man or an audience of thousands. Soon I had won salary increases, promotion, popularity, power. Today I always have a ready flow of speech at my command. I am able to rise to any occasion, to meet any emergency with just the right words. And I accomplished all this by developing the natural power of speech possessed by everyone, but cultivated by so few—by simply spending 15 minutes a day in the privacy of my own home, on this most fascinating subject.

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- How to acquire a winning personality
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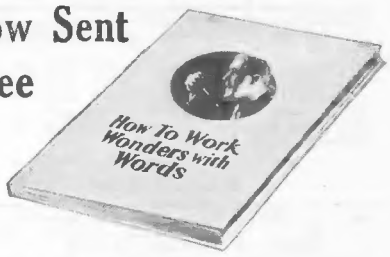

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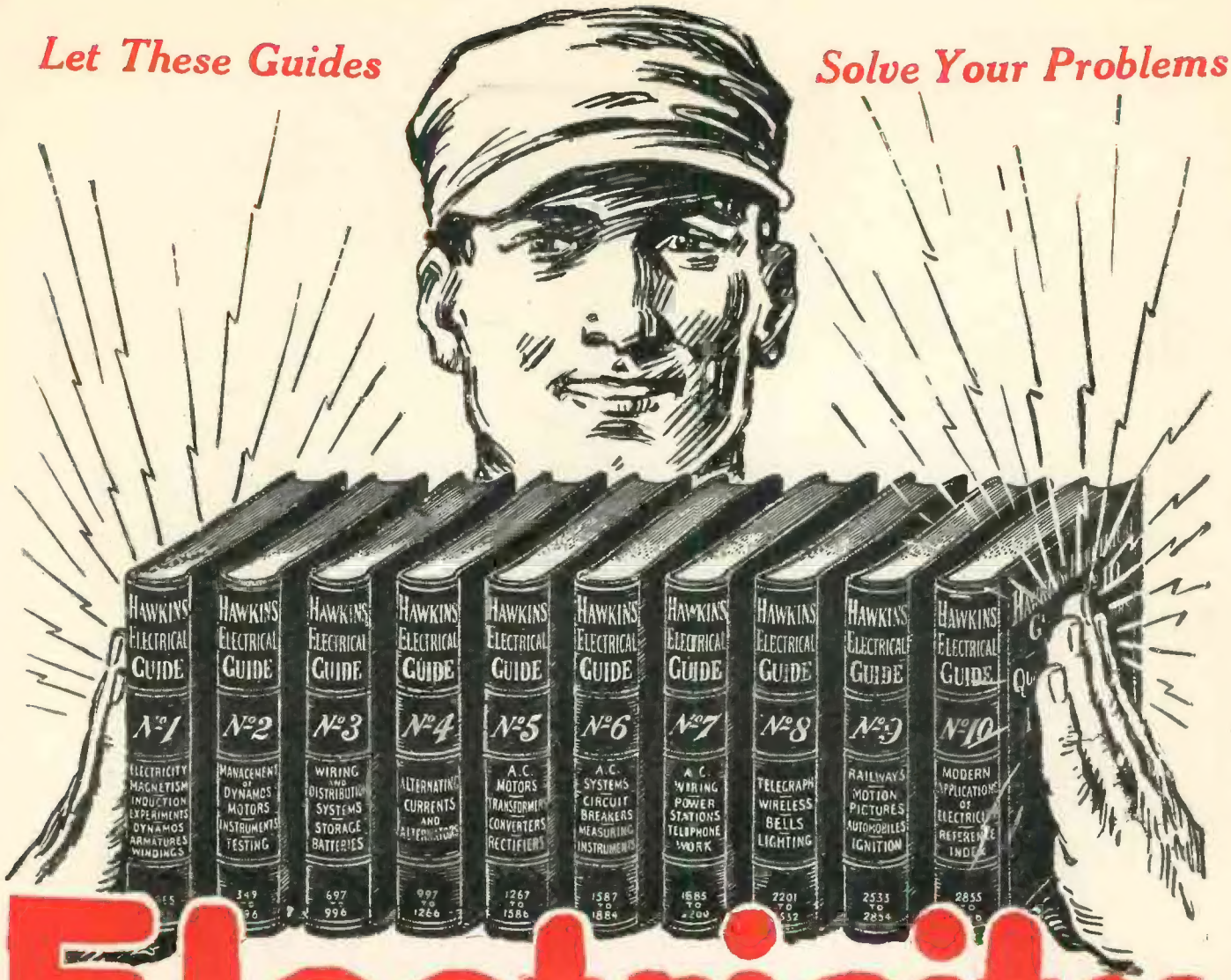

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